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GLOBAL CLIMATE CHANGE: CATALYST FOR
INTERNATIONAL RELATIONS
DISEQUILIBRIA?

by

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A DISSERTATION

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the Department of Political Science
in the Graduate School of
The University of Alabama

TUSCALOOSA, ALABAMA

2004

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LIST OF ABBREVIATIONS AND SYMBOLS

AFL-CIO	American Federation of Labor-Congress of Industrial Organizations
AOSIS	Alliance of Small Island States
CDIAC	Carbon Dioxide Information Analysis Center
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
COPs	Conference of the Parties
DSP	Dominant Social Paradigm
EDGAR	Electronic Data Gathering Analysis Retrieval
ESI	Environmental Sustainability Index
ERUs	Emission Reduction Units
EU	European Union
GATT	General Agreement on Tariffs and Trade
GCC	Global Climate Change
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
IEA	International Energy Agency
IGOs	Intergovernmental Organizations
IOs	International Organizations
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation

MNCs	Multinational Corporations
NEP	New Environmental Paradigm
NGOs	Non-governmental Organizations
NRC	National Research Council
OECD	Organization for Economic Cooperation and Development
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USEPA	United States Environmental Protection Agency
USSR	Union of Soviet Socialist Republics
WRI	World Resources Institute
WWF	World Wide Fund for Nature

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ABSTRACT

Climate was the dominant influence on geopolitical theory and international relations before the industrial revolution. Early scholars, such as Aristotle and Montesquieu, divided the world into temperature zones and the climatic forces in these zones were thought to be major influences on the political, social, and economic institutions that developed. Modern innovations like air conditioning and disease vaccines contributed to a process that dramatically lessened the influence of climate on international relations. However, other modern innovations such as coal-fired electric plants and gasoline-powered automobiles, as major factors contributing to global climate change, may reverse that process.

The consensus of most of the world's climatologists is that global climate change is essentially an anthropogenic process that will probably cause the world to warm from 2.2°F - 10°F (1.4°C - 5.8°C) by the year 2100. As a consequence, sea levels will probably rise and some plants and animals could become extinct. Overall, researchers conclude most consequences of climate change will probably not be benign, climate change cannot be stopped, and as a result global efforts are needed to mitigate or adapt to the consequences. As a result, the costs of mitigation or adaptation could be substantial or the costs could be moderate, depending on how the challenge is addressed. In effect, global climate change may become an environmental force, a catalyst for international relations change that must be reckoned with soon very soon.

The changing climate could be an environmental catalyst that may precipitate political, social, and economic transformations. Politically, the consequences of global warming could initiate replacement of the dominant international relations paradigm. Realism may be replaced by liberalism as the preeminent theory of international relations. Socially, the impacts of global climate change might drive the dominant social paradigm from its perch as the most applicable social environmental paradigm, replaced by ecological modernization theories. Last, the reign of the neo-classical economic paradigm may come to an end. Essentially, ecological economics may answer the environmental-economic puzzles created by global warming more completely than conventional, neo-classical economics. If the political, social, economic, and environmental forces associated with global climate change hastens paradigm changes a new equilibrium may be established based on a synthesis of the paradigm change winners, liberalism, ecological modernization, and ecological economics, perhaps described as liberal economic ecology. In conclusion, global climate is one of the most powerful political, social, economic, and environmental forces that man has ever encountered and could potentially catalyze profound global changes in one form or another.

ABSTRACT

Climate was the dominant influence on geopolitical theory and international relations before the industrial revolution. Early scholars, such as Aristotle and Montesquieu, divided the world into temperature zones and the climatic forces in these zones were thought to be major influences on the political, social, and economic institutions that developed. Modern innovations like air conditioning and disease vaccines contributed to a process that dramatically lessened the influence of climate on international relations. However, other modern innovations such as coal-fired electric plants and gasoline-powered automobiles, as major factors contributing to global climate change, may reverse that process.

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CHAPTER I

GLOBAL CLIMATE CHANGE, INTERNATIONAL RELATIONS DISEQUILIBRIUM: CAUSE AND EFFECT

Introduction

Environmental issues have had and continue to make an impact on international relations studies. Many of these issues have the potential to add depth to the study or even to transform the study of international relations (Dyer 2001). The proliferation of international environmental agreements and subsequently environmental institutions provide ample research opportunities for political science scholars. Presently, states and statesmen must contend with attacks on sovereignty by environmental regimes and institutions designed to deal with global problems that require global solutions. The boundaries between international issues, environmental issues, and governance issues have become less clear and more porous.

The relationship between the environment and economic development is another research area worthy of exploration. Recent scholars have already noted the interdependence between complex environmental problems and other international relations functional issues, to include security, cooperation, integration, power, equity, welfare, and freedom (Young 1989; Keohane et al. 1993; Simon 1996; Jones 1997; Homer-Dixon 1999; Claussen and McNeilly 2000; Michaels and Balling 2000; Gupta 2001; Luterbacher and Sprinz 2001; Schneider, Rosencranz, and Niles 2002; Holden 2002; Rosenbaum 2002; Steel, Clinton, and Lovrich 2003). Additionally, the

relationship between sustainable development strategies and current global economic growth policies illustrate another challenge to international relations academics, the “environmental dimension of globalization” (Dyer 2001). These studies will bring out the inherent conflicts between science and risk, between what we are certain of and what we are uncertain of, and how to respond effectively. This is the ultimate dilemma of global climate change. In particular, awareness that global environmental degradation has social, political, and economic origins (Kuetting 2000) as well as certain and uncertain social, political, and economic consequences.

The plan for study of the relationship between climate change and international relations has multiple facets. The first facet is the basic introduction of the history of the problem, what the problem is, and some of the potential impacts. The second component involves grounding the discussion in a brief literature review of pertinent source material. The third element is a direct assault on the potential for climate change to unhinge the balance between the two dominant worldviews, realism and liberalism. The fourth facet examines the relationship between the dominant anthropocentric social paradigm and new ecocentric social paradigms. The fifth scheme investigates the economically based disequilibrium between the worlds’ rich and poor and how this mal-distribution will be affected by global climate change. The last component presents conclusions on the overall effect of global climate change on international relations based on the previous deliberations.

History of Climate and International Relations

Climate was the dominant influence on geopolitical theory and international relations before the industrial revolution (Deudney 1999). Early scholars, such as Aristotle and Montesquieu, divided the world into temperature zones and the climatic forces in these zones were thought to be major influences on the political, social, and economic institutions that developed. Some ancient scholars believed that the temperate zones were the most conducive to creating great civilizations and good governance while others contended that northern climates were more favorable to the advancement of civilization. In particular, some early climate researchers concluded that the tropical zones “produced torpor, which retards material advance and induces political passivity and a predisposition for despotism” (Deudney 1999, 35). However, as modern social science gathered more information on the causes of political, economic, and social development geopolitical theories lost relevance and support. Nevertheless, a small number of scientists continued to research the effects of climate on political, social, and economic progress.

Modern geopolitical theories include climatic, topographical, and positional factors in the analysis of international relations and world social, political, and economic growth. For example, researchers argue that strong winters in Europe prevented the transmission of tropical diseases to Europe from tropical Asia and Africa. These tropical diseases (Malaria, schistosomiasis, yellow fever, etc.) are asserted to have slowed early political, social, and economic development in most of tropical Asia and Africa compared to European development. This “disease curtain” is also argued to

have prevented early European penetration into the center of Africa, the Amazon Basin, and the tropical parts of South East Asia (Kamarck 1976). Additionally, medieval Europe's significant climatic range allowed Europeans to produce a wide variety of tradable bulk goods (e.g. wine, cork, timber, grain, wool, and fish) that enabled Europe to become the trade center of the medieval world (Deudney 1999; Diamond 1999). Interestingly, a strong correlation between economic development levels and climate regions still exists with the greatest levels of economic growth in temperate regions and the lowest levels of economic progress in the tropical regions. Possible explanations for this relationship center on the disease and physiological constraints induced by high humidity and temperature levels found in the tropics (Kamarck 1976). In addition, climate studies have found remarkable climate changes have occurred in the past that have had significant and diverse effects on human populations.

Dramatic climate induced changes in social, political, and economic life has occurred in the past and may be occurring now. An example of a past momentous climatic event, the "Little Ice Age" from about 1400-1900 AD caused widespread hardship all over Europe. The colder weather destroyed crops, increased social strife, depressed economies, forced migration to more hospitable climes, and even affected the art and literature of those times (Lamb 1982). An example of a catastrophic climatic event that is probably the most dramatic climate change of the last 10,000 years is the "super flood" in Canada about 8,500 years ago. The flood was caused by the rupture of a massive glacier-dammed lake in Canada at the end of the Ice Age and the resulting gigantic flood of fresh water into the Atlantic Ocean altered the ocean circulation in the Northern Hemisphere. After the flood the mean global temperature dropped by 5°C,

snow accumulation decreased sharply, and forest fires became more frequent and these climate related events lasted for approximately 200 years (Clarke et al. 2003).

Although the effect on humans is not widely understood it can be speculated that the depressed temperatures would have had enormous negative consequences for early primitive human populations.

Present day climate researchers are also concerned that dramatic climatic events could significantly alter global social, political, economic, and environmental processes. Climate scientists assert that tropical climate zones may increase as global temperatures increase (IPCC WGII, 2001). Also, the dilemma of global climate change may stimulate a re-awakening of geopolitical considerations based on increases in disease, heat, and humidity constraints as well as other factors that may have negative consequences for international relations. The question emerges: can climate geopolitics affect international relations? This dissertation will investigate that question.

The Climate Change Problem

Global climate is changing and the predicted changes in our climate have potential impact on every person, in every state on the planet socially, economically, environmentally, and politically (NAST 2000; IPCC WGII, 2001). The largest international scientific organization directly chartered to study global climate change, the Intergovernmental Panel on Climate Change (IPCC), has concluded the Earth's climate is warming and other important aspects of climate change are occurring (IPCC WGI, 2001). Extensive research efforts by hundreds of scientists from many countries from around the world have contributed to the preparation of the three major IPCC

reports printed in 1990, 1995, and 2001. Furthermore, thousands of experts drawn from governments, universities, industry, and non-governmental organizations with a wide range of expertise and perspective have reviewed and commented on these three assessments of climate change (NAST 2000; IPCC WGI, II, III, 2001). Finally, perhaps final straws breaking the climate change uncertainty camel's back are the results of two large meta-analyses (Pugh 2003).

In a study of hundreds of data sets, Parmesan and Yohe explored the connections between numerous species, biological measures, and geographic locations that tracked climate changes over several decades. Their global meta-analyses of 334 species and global analyses of 1,700 species revealed patterns of change that were consistent with global warming and were highly significant statistically. Specifically, they found significant range shifts averaging 3.8 miles (6.1 km) per decade towards the poles or to higher altitudes and significant mean advancement of spring events (such as breeding of birds or blooming of plants) by 2.3 days per decade (Parmesan and Yohe 2003; Pugh 2003). Even when the researchers considered other factors that affect plant and animal behavior like habitat destruction, the analyses strongly concluded that climate change was the most important variable.

The second study by Root et al. was a meta-analysis of 143 studies of plant and animal species from around the world. The study analyzed changes in the timing of biological events of over 1,400 species ranging from grasses to trees and from mammals to mollusks and a marked shift toward earlier spring events by over 80% of the species studied was found (Root et al. 2003). The detailed and exhaustive assessments and

reviews have drawn needed attention to the greatest potential environmental threat to human life ever confronted: human induced warming of the planet's atmosphere.

Global average surface temperatures have increased during the 20th century by about 1°F (0.6°C), which is likely the largest increase in temperature of any century in the past 1,000 years (IPCC WGI, 2001). The IPCC concluded: "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities" (IPCC WGI, 2001, 10). Additionally, the IPCC predicts that by the year 2100 the global temperature will have increased from 2.2°F - 10°F (1.4°C - 5.8°C) (IPCC WGII, 2001). Finally, the IPCC has also determined that "anthropogenic climate change will persist for many centuries" (IPCC WGI, 2001, 17).

The earth's atmosphere is being altered by increasing emissions of greenhouse gases and aerosols that are created by anthropogenic processes (IPCC WGI, 2001). Increasing amounts of carbon dioxide (CO₂), methane (CH₄), and other gases (nitrous oxides (NO_x), chlorofluorocarbons (CFCs) and hydrochloroflourocarbons (HCFCs)) from human controlled processes are adding to the Earth's natural greenhouse effect creating an "enhanced" greenhouse effect that is often described as "global warming" (Houghton 1997; Schneider, Rosencranz, and Niles 2002). The primary sources of greenhouse gases are deforestation, energy production by combustion of fossil fuels (natural gas, oil, and coal), transportation activities (cars and trucks primarily), cattle production, rice farming, and cement production. These human activities are intensifying greenhouse effects that have had and could have a variety of consequences for biological and physical systems worldwide.

Recent temperature increases have already had a wide variety of effects on wildlife and other environmental systems. Birds are laying eggs a few weeks earlier, butterflies are moving up mountains, and trees are blooming earlier in spring and losing their leaves later in the fall, snow and ice extant have decreased, glaciers worldwide are retreating, sea levels and ocean heat contents have risen, and rainfalls patterns in many regions have changed (IPCC WGII, 2001; Root and Schneider 2002; Parmesan and Yohe 2003; Root et al. 2003). Specifically, range boundaries of 62% of 677 species assessed have shifted an average of 6.1 kilometers northward or 1 meter upward per decade and 90% of all phonologic changes observed were within parameters expected from climate change influences (Parmesan and Yohe 2003). Additionally, spring events in temperate zones have been occurring on average 5.1 days earlier during each decade (Root et al. 2003). Finally, permafrost is thawing in the Polar Regions, lakes are freezing later and thawing earlier, and even some plant and animal species populations have declined due to climate changes (IPCC WGII, 2001). The predicted effects of climate change are even more imposing and expansive.

The 21st century may be the century of global warming and the effects will probably impact a broad range of physical and biological systems. Table 1 displays the effects that scientists have the highest confidence (67-99% probability) of occurrence:

Table 1. Projected Effects of Climate Change for the 21st Century (IPCC WGII, 2001, 7)

Projected Effects	Probability Estimate	Examples of Projected Impacts
Higher maximum	Very likely (90-99%)	Increased deaths and serious illness in older age groups and urban poor

temperatures, more hot days and heat waves over nearly all land areas		Increased heat stress in livestock and wildlife Shift in tourist destinations Increased risk of damage to a number of crops Increased electric cooling demand and reduced energy supply reliability
Higher minimum temperatures, fewer cold days, frost days, and cold waves over nearly all land areas	Very likely (90-99%)	Decreased cold-related human morbidity and mortality Decreased risk of damage to a number of crops and increased risk to others Extended range and activity of some pests and disease vectors Reduced heating energy demand
More intense precipitation events	Very likely (90-99%) over many areas	Increased flood, landslide, avalanche, and mudslide damage Increased soil erosion Increased flood runoff increasing recharge of some floodplain aquifers Increased pressure on government and private flood insurance systems and disaster relief
Increased summer drying over most mid-latitude continental interiors and associated risk of drought	Likely (67-90%)	Decreased crop yields Increased damage to building foundations caused by ground shrinkage Decreased water resource quantity and quality Increased risk of forest fires
Increase in tropical cyclone peak wind intensities, mean and peak precipitation intensities	Likely (67-90%) over some areas	Increased risk to human life, risk of infectious disease epidemics, and many other risks Increased coastal erosion and damage to coastal buildings and infrastructure Increased damage to coastal ecosystems such as coral reefs and mangroves
Intensified droughts and floods associated with El Nino events in many regions	Likely (67-90%)	Decreased agricultural and rangeland productivity in drought- and flood-prone regions Decreased hydro-power potential in drought-prone regions

Increased Asian monsoon precipitation variability	Likely (67-90%)	Increase in flood and drought magnitude and damages in temperate and tropical Asia
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The multifaceted and extremely complex effects of global climate change could have enormous impacts on human society. Lowland tropical diseases may spread to previously impervious plateaus, mountains, and temperate regions (Balbus and Wilson 2000). The relative rapidity of climate change will probably also adversely affect various plant and animal species because of their inability to migrate fast enough to new climate hospitable niches (Houghton 1997; Malcolm and Pitelka 2000; Schneider 2002; Willis 2002). A joint team of botany and climatology scientists have determined that, based on mid-range climate warming scenarios, by 2050 15% - 37% of the species in the sample of regions they studied would become extinct (Thomas et al. 2004). The study sample region covered over 20% of the Earth's terrestrial surface. Such a dramatic loss of species could cause immeasurable damage to most of the planet's ecosystems and untold damage to humans reliant on those ecosystems for subsistence. Additionally, as climate changes agriculture and forestry could be impacted positively in some regions while other regions could experience overall negative impacts (Adams, Hurd, and Reilly 1999; IPCC WGII, 2001). Fresh water resources will probably be negatively affected by droughts, floods, saltwater intrusion, and uncertainty in quantity and quality of supplies (Fredrick and Gleick 1999). Rising sea levels induced by

increasing oceanic temperatures will probably also negatively affect human coastal populations worldwide.

The National Academy of Science's National Research Council (NRC) predicts that rises in sea levels caused by thermal expansion of the oceans and melting of polar ice, as a result of global warming, are expected to continue through the 21st century (NRC 2001). Data from the IPCC indicates sea level increases ranging from about 6 inches to 36 inches (15 cm to 1 meter) by the year 2100 (IPCC WGII, 2001). Obviously, sea level rise can have catastrophic implications for many low-lying states. For example, in Bangladesh over 10 million people would be displaced by a 36-inch (1-meter) rise in sea level. The Nile delta region of Egypt would also be dramatically affected. Twelve percent of Egypt's arable land, supporting a population of over 7 million people, would be inundated by a 36-inch (1-meter) rise in sea level. The IPCC concluded that projected increases in temperature would result in "a widespread increase in the risk of flooding for many human settlements (tens of millions of inhabitants in settlements studied) from both increased heavy precipitation and sea level rise" (IPCC WGII, 2001, 5). Consequently, sea level rise and changes in climate patterns (more severe hurricanes, cyclones, tornadoes, droughts, and floods) from global climate change will probably affect large populations around the planet (See Table 1) (Neumann, Yohe, and Nicholls 2000). Included in the assessments are predictions of less likely but more intensely dramatic changes in large scale patterns of ocean circulation or even the disintegration of the Antarctic Ice Sheet as a result of climate change (Houghton 1997; Schneider, Rosencranz, and Niles 2002; IPCC WGI, 2001).

Some climate scientists predict the disruption of the enormous ocean thermohaline circulation (THC) system. The Northern Atlantic Ocean section of the THC system currently discharges heat to the high latitudes of the Northern Hemisphere. Increased temperatures in Northern climes due to global warming could melt Arctic ice caps and the resulting freshwater runoff into the Northern Atlantic could disrupt the THC and stifle release of excess heat to the atmosphere at high northern latitudes (Aharon 2003). As a result, Europe and the Eastern coast of the US would endure much colder winter weather and more extreme temperature swings than seen today (Schneider, Rosencranz, and Niles 2002). Finally, in the unlikely event that the West Antarctic Ice Sheet melts the oceans of the world would rise by over 20 feet (approximately 7 meters) inundating almost every coastal city around the world (Schneider, Rosencranz, and Niles 2002). These dire scenarios, however, are dependent on certain modeling assumptions, ice dynamics, and other climatic factors (IPCC WGI, 2001).

Climate change is a global phenomenon that defies regional or national responses. Many researchers agree, "Climate change is a global problem that demands a global solution because emissions from one country can impact the climate in all other countries" (Claussen and McNeilly 2000, 1). The approximately 170 states that make-up the global community each have different interests, objectives, and strategies in relation to climate change, but all must cooperate if an answer is to be found. Damage to coastal areas, loss of biodiversity, altered agricultural patterns, changes in rainfall patterns, intensified air pollution, and spread of infectious diseases will probably affect health care costs, property insurance costs, and worker productivity at a minimum and

costs lives at the extreme (Claussen and McNeilly 2000; IPCC WGII, 2001). The potential for destabilization of weak governments and the creation of millions of environmental refugees is inherent in the unequal effects of global climate change as weather patterns change globally (Myers 1993; IPCC WG II, 2001). Whether powerful or weak, rich or poor, state-centric or multi-centric, human-centered or nature-centered all states could be affected by the consequences of global climate change, but not all the same.

The bottom line is that certain global imbalances could be accentuated to new and potentially dangerous heights by global warming, potentially degrading global international relations. This line of thought indicates that these imbalances require more scholarly attention and investigation if an effective and timely global response is to be crafted.

The Effects of the Climate Change Problem

Global changes to the Earth's climate portend a staggering array of physical and biological disruptions that could have enormous consequences for human civilization. Much is already known about the current and potential chemical, biological, physical, environmental, and ecological effects of global climate change (NAST 2000; NRC 2001; IPCC 2001). Much less is known about the potential social, economic, and political effects of global warming. This study attempts to apply an analytical framework to an environmental change case study based on global climate change predictions. The objective of the case study is to better understand the international relations implications of this very unusual environmental problem.

As a global environmental challenge, global warming is unique in at least three significant ways. First, global climate change has become the first environmental problem that affects the entire planet and therefore is an issue concerning global public goods (Nordhaus 2001). Other significant environmental problems, like tropical deforestation, rising cropland scarcity, fisheries depletion, scarcity of freshwater, over population, and loss of biodiversity, have only affected certain (although wide-ranging) areas of the planet and differ greatly in their regional impacts and responses. All are “tragedies of the common” in some respects but only global climate change and ozone depletion can manifest themselves as truly global physical and social challenges (Myers 1993a, 1993b; Homer-Dixon 1999; Brown et al. 2000). Fortunately, ozone depletion predominately affects the polar regions of the globe at this time and specifically, climate change is unique from ozone depletion in that no adequate global response has been identified and implemented. Consequently, any accord on climate change would be the first truly global environmental agreement dealing with global economic public goods (Nordhaus 2001). Second, responses to global climate change could have direct impacts on two of the driving forces of the global economy, energy production and transportation. Energy production processes and transportation industries are the two major sources of greenhouse gases and if climate change is to be stabilized these industries will probably have to endure major reformation and redesign. Thus, no other global environmental issue has the potential to have such an enormous impact on the global economy as global climate change. Finally, global warming is the only environmental change problem that intensifies or is intensified by other major environmental problems.

Tropical deforestation releases enormous quantities of greenhouse gases into the atmosphere, destroying potential carbon sinks, while healthy tropical forests absorb huge quantities of greenhouse gases (Niles 2002). Increasing temperatures are intensifying desertification pressures and thus increasing cropland scarcity (Pearson 2002). Rising sea levels are destroying fertile wetlands, mangrove swamps, and estuaries and higher oceanic temperatures bleach corral reefs destroying vital nurseries and habitats for many valuable aquatic species (IPCC WGII, 2001). Consequently, sea level rise and warmer oceanic temperatures are deadly multipliers to the depletion of global fisheries and marine ecosystems. Additionally, changing precipitation patterns and uncertain rainfall levels only add to the scarcity of freshwater (Frederick and Gleick 1999). Increasing human populations also entail amplified demands for energy and transportation globally and ultimately the release of more greenhouse gases into the Earth's atmosphere (Meyerson 2002). Last, climate changes are occurring too fast for many species to adapt to and the resulting loss of biodiversity is especially troublesome as each lost species will probably ultimately affect the survival of several more interdependent species (Wilson 1992; IPCC WGII, 2001; Niles 2002). Surely, unprecedented political and social international relations ramifications could accompany any attempts to modify the global economy in response to climate change and these international relations issues deserve immediate attention. The first step in investigating these ramifications will begin with a thesis question.

Dissertation Questions

The underlying research question for this dissertation is: “What will be the effect of global climate change on international relations?” A framework to answer this question and analyze global climate change thoroughly comes from an analytical structure offered in *Environmental Change, Adaptation, and Security* (Matthew 1999). Application of this agenda to the thesis question will hopefully better inform scientists, politicians, and citizens on the multifaceted, complex, and intense challenges that global warming presents. The analytical skeleton involves the following three “dynamic and interactive disequilibrium evident in the international system” (Matthew 1999, 17).

1. Global climate change could create a disequilibrium between dominant international relations worldviews.
2. Global climate change could create a disequilibrium between human social systems and natural ecological systems.
3. Global climate change could create a disequilibrium between rich and poor (Matthew 1999).

Each of the hypotheses focuses on global level imbalances that often perplex and confound the students and practitioners of international relations. As stated before, global climate change could create social, political, economic, and environmental forces that could arouse, inflame, and power these disequilibria. These forces could push the international system to new, profound, and perhaps dangerous equilibrium points. Consequently, comprehension of these forces will enrich our understanding of how environmental change can become a global challenge and is essential in shaping positive, efficient, and effective international response strategies. As such, each imbalance presents its own unique challenge to analysis and evaluation.

Worldview Disequilibrium

The potential disequilibrium between dominant worldviews induced by climate change involves the ongoing battle in international relations between the proponents of realism and the supporters of liberalism. Realists, with their focus on the primacy of the state inhabited by selfish humans, the central position of power/security relationships between states, and the inherent necessity of state sovereignty in a basically anarchic world, have long held sway over many international relations dialogues (Morgenthau 1978; Waltz 1979; Baldwin 1993; Goldstein 2003). Liberals, alternatively stressing the primacy of basically self-interested individuals, the guiding force of international law, the centrality of morality, and the cooperative power of international organizations for a global community, have recently gained ground on realists (Keohane 1989; Young 1989; Matthew 1999; Goldstein 2003). Global climate change may accentuate the battle between dominant worldviews and potentially force one paradigm to become the focal point of international relations policy decisions.

In a realist driven scenario, changes in the global climate could force rational, self-interested states into an intense competitive and anarchic situation where emissions of greenhouse gases become the currency of the powerful and weak. Large producers of greenhouse gases could be forced to trade for, buy, or bargain for emission credits from states that do not produce large quantities of climate changing greenhouse gases (Moore 1998; Kronick 1999).

In another plausible scenario the large producers will consolidate their power positions and force small producers to hand over emission credits. Thucydides (1954)

will again see the strong doing what they have to do and the weak suffering what they must. A bleaker vision is one where the powerful states simply purchase protective and adaptive measures from the multiple adverse effects of climate change. The powerful simply build dikes/levees to protect from sea level rise, move inland and rebuild cities that were inundated, seize food stuffs from agricultural producers not negatively affected by or benefiting from climate changes, take fresh water sources from those that have them, rebuild structures destroyed by violent weather, deploy more pesticides to prevent the spread of malaria and other tropical diseases, install more air conditioners, and discount the loss of numerous species to extinction from habitat loss as a trivial side-cost of maintaining dominance. The powerful simply hunker down and wait out the global climate storms.

In liberal driven scenarios concern for the global community will dominate discussions on how to best address climate change. Fair, equitable, balanced, and market driven measures are jointly implemented by the global community via international organizations that reduce and eventually stabilize greenhouse gas emissions at levels that prevent global catastrophe (Moss 1991; Petsonk, Dudek, and Goffman 1998; Claussen and McNeilly 2000). New, climate benign energy and transportation technologies are introduced and shared between all states (Bernstein et al. 1999; Rosenbaum 2002). Environmentally sound and climate friendly sustainable agricultural and forestry practices are mandated to address carbon sink issues and food production concerns (Malcolm and Pitelka 2000). States threatened by sea level rise receive international support and relocation of displaced populations will become a global priority when required. Also, effective responses to catastrophic weather events

become a global concern and receive regional and if necessary global attention and support (Claussen and McNeilly 2000). Global climate change forces states to cooperate in order for all to survive and liberal foundations of international law, international organizations, and democracy (Kantian principles) are the engines of cooperation (Oneal and Russett 1997; Russett, Oneal, and Davis 1998; Russett and Oneal 2001). However, certain issues concerning global climate change can create a collective goods problem, a bane to many liberal theories of cooperation and effective global climate change policy responses.

A collective good is often defined as a tangible or intangible good, created by members of a group, that can be utilized by all members of the group, irrespective of any contributions to the greater good. The problems of relative distribution of costs, protectionism, and free riders create dilemmas for liberal worldview supporters (Goldstein 2003). Short-term and predictable losses in order to gain long-term yet less predictable benefits must be borne by specific industries, organizations, or groups in the name of the global masses. Eventually, global climate change creates a situation where the benefits of global climate change intervention, climate change mitigation, are shared globally but the costs of global climate change, global economic transformations, must be borne by each state individually and unequally (Olson 1971; Goldstein 2003). The dilemma caused by this collective goods problem is intensified by the difficulty large groups (states) encounter when trying to achieve collective goals through voluntary collective action (Olson 1971, 1993).

The two international relations paradigms present two very dissimilar potential futures, yet one could dominate the response to global climate change. Not only could

political worldviews clash, social views may conflict, and rich and poor might vie for control of the global climate change agenda.

Social and Ecological Systems Disequilibrium

Many social scientists believe that we are in middle of a dramatic paradigm shift from the industrial era dominant social paradigm (DSP) to a new environmental paradigm (NEP). Each paradigm has vastly different orientations on how humans should manage natural resources and on the central relationship between humans and the natural environment. Global climate change may hasten the transition to the NEP or create conditions where the old DSP is revitalized.

Steel, Clinton, and Lovrich describe the DSP as follows:

The main theme underlying the DSP is that economic growth, international trade, and continuing innovations in science and technology will continue to improve the human condition by reducing poverty and increasing the relative equality among nations. Population growth is seen as a primary means to increase consumption and production capacity simultaneously, thus stimulating economic growth. Capital accumulation and strategic investment in general, and the maintenance of open markets in particular, are seen as the best means of promoting economic growth. Proponents of this approach typically oppose planning, especially by governments, viewing legally sanctioned plans as creating unwarranted constraints on entrepreneurial activity and establishing faulty prices on goods and services in commerce (Steel, Clinton, and Lovrich 2003, 11).

The DSP is also described as “a worldview that is pervasive in a society and comes to underlie governmental decision making and citizen beliefs and values concerning proper public policy” (Steel, Clinton, and Lovrich 2003, 10). In addition, a central theme to this viewpoint is an anthropogenic (human-centered) perspective where people are the only objects with value in the natural world (Steans and Pettiford 2001). Specifically, the most important objective of environmental policy and resource

management procedures is maximizing production of goods and services for the benefit of people and human societies (Steel, Clinton, and Lovrich 2003). As such, natural systems do not have rights and therefore can be used by humans as they see fit for their own ends (Steans and Pettiford 2001). Under the sway of anthropocentrism and the DSP, humans will continue to produce greenhouse gases in increasing rates expecting the resilient Earth to accommodate the exploitation or relying upon advances in science and technology to come to the rescue and overcome any climate change surprises (Steel, Clinton, and Lovrich 2003). The potential successor to the DSP, the NEP was proposed in the latter half of the twentieth century and has become extremely popular in many post-industrialized states, such as the US, Japan, and countries in the European Union (EU) (Dunlap and Van Liere 1984; Brown and Harris 1992; Milbrath 1993; Dunlap and Catton 1994).

The NEP, an ecocentric perspective, contends that ecosystems and natural resources need systematic protection and conservation (Steel, Clinton, and Lovrich 2003). Advocates of this paradigm express:

...deep concern over population growth and current rates of natural resource consumption. They argue that unrestricted population and unplanned economic growth will have deleterious long-term consequences for the Earth and all its living inhabitants. They argue that climate change, stratospheric ozone depletion, loss of forested lands, and similar developments could lead to catastrophic environmental events unless people mend their wasteful, and too often, inconsiderate ways. NEP advocates maintain that we must plan for the future we want, and we must promote cooperation among the people and nations of the world to carry out these plans (Steel, Clinton, and Lovrich 2003, 11).

Discussions and analysis of the new environmental paradigm has illuminated disagreements and inconsistencies between human ecology (Buttel and Humphrey 2002; Humphrey, Lewis, and Buttel 2002), political economy (O'Connor 1991, 1996,

1998; Schnaiberg and Gould 1994; Seligson and Passé-Smith 1998), modernization (Giddens 1991, 1994, 2000; Beck 1992; Grossman and Krueger 1995; Inglehart 1995, 2000; Lash, Szerszynski, and Wynne 1996; Mol 1996; Stern 1998; Nordstrom and Vaughan 1999; Mol and Sonnenfeld 2000), world system (Wallerstein 1974), and ecology first (Catton and Dunlap 1978; Dunlap and Catton 1994; Foster 1997, 1999, 2000) researchers and theories.

Especially relevant in the NEP is the concept that all humans are part of the larger, Earth ecosystem, and that every creature, great and small, is linked to every other ecosystem in complex and often misunderstood ways (Milbrath 1993). Supporters of this paradigm point to the continuing dire poverty and living conditions in many undeveloped states, the rampant destruction of ecosystems worldwide, the unequal application of environmental standards when pressured by economic growth considerations, and the growing potential for social and ecological apocalypse (Ehrlich 1968; Meadows 1972). NEP advocates view the claims by DSP supporters that science and technology will alleviate shortages of resources, poverty, and correct many of today's environmental problems (Bailey 1993; Simon 1996; Lomborg 2001) with special concern and often disbelief. NEP critics point out that many of the so-called advances in science and technology have greatly altered or have the potential to greatly alter the global environment in negative ways. For example, genetic engineering, nuclear energy, and nuclear/biochemical weapons are such powerful technologies that the misuse of or an accidental event involving these technologies would have disastrous global implications (Steel, Clinton, and Lovrich 2003). Global climate change, a

product of the rapid and often environmentally destructive industrialization of countries around the world, is also seen in this light.

The conflict between the dominant social paradigm and the new environmental paradigm could be exacerbated by global climate change. DSP relies on science and technology to continue economic growth and global climate change threatens the driving forces of economic expansion: energy, transportation, agriculture, and most modern industrial processes. Greenhouse gases, as byproducts and products of modern industrial processes, will have to be reduced if the principles of the NEP are to be met. Global climate change threatens not only human progress but also ecological stability and consequently one paradigm could dominate and another may lose influence. Rich and poor may also clash along several different dimensions in the struggle to determine who controls global climate change policy decisions. Global climate change affects development, sustainability, and equity issues by creating disequilibriums among the various rich and poor actors (Matthew 1999). This disequilibrium can be analyzed from three perspectives: conflict between states, conflict between non-state actors, and conflict between individuals.

Rich and Poor Disequilibrium

The global climate change debate has strong economic dimensions that outline the last disequilibrium discussed. The disequilibrium can be framed using many different qualifiers. For example, the climate change discussions between rich and poor from the state level of analysis are a contest between the rich, developed countries and the poor, undeveloped countries. Perceptions of the developed states as “Western,”

“colonial,” “capitalists,” “Northern,” or “First Tier” continue to infuse the climate debate with ideologies, passions, and assumptions seen through the lens of political history (Dos Santos 1970; Snow 2000; Gupta 2001; Rosenbaum 2002). In particular, undeveloped states argue they must have help to cope with global warming and its consequences (Moss 1991) and yet many undeveloped states are wary of any US or Western diplomatic initiatives as they suspect covert attempts at exploitation and subjugation (Dos Santos 1970; Gupta 2001; Agarwal 2002; Rosenbaum 2002).

Technology transfers and economic assistance to help undeveloped countries develop cleaner sources of energy and transportation that produce little or no greenhouse gases are advocated by all undeveloped states (Gupta 2001; Agarwal 2002; Baer 2002). Just how urgent these transfers/assistance needs are is exemplified by Malawi’s Minister of Forestry, Fisheries, and Environmental Affairs statement at the Kyoto conference:

“How can we devote our precious resources toward reducing emissions when we are struggling every day just to feed, clothe, and house our citizens?” (Rosenbaum 2002, 368). However, many developed states view the climate change debate as just another blatant attempt by the undeveloped states to force a transfer of wealth from the richer developed states to the poorer undeveloped states. Some researchers have concluded that, “Climate policy has become foreign aid” (Moore 1998, 128). Yet many policy makers believe that climate change is the greatest challenge to North-South cooperation the world has ever seen (Agarwal 2002). Also, at the state level are disagreements among the rich and among the poor states.

Some states that are in better positions to reduce greenhouse gas emissions want early actions and deep cuts (Great Britain, France, and Germany) while some wealthy

fossil fuel exporting countries (OPEC states primarily) want to delay action and demand compensation for losses in revenues (Claussen and McNeilly 2000). Some poorer states that will probably be dramatically affected by global climate change plead for immediate and dramatic cuts (low-lying island nations), while other undeveloped countries (India and China) do not want to accede to anything that will hurt their economic growth (Gupta 2001). The debate also could divide non-state actors into different rich and poor camps.

Many non-state actors see global climate change as a threat to competitiveness, profits, and economic growth (Exxon, CATO Institute, General Motors (GM), etc...) while other actors view the issue as a tremendous opportunity to reshape global economics (British Petroleum (BP), Ballard Fuel Cells Inc., environmental groups, etc...) (Anderson 2002; Rosencranz 2002). Specifically, reduction of greenhouse gases will probably cause economic disadvantages to coal, possibly oil and gas, and certain energy-intensive industrial sectors, such as steel production. Industries that focus on renewable energy technologies and services will probably have many economic advantages over these carbon-intensive industries (IPCC WGIII, 2001). Also, disagreements have arisen between organizations that support free trade (World Trade Organization (WTO), International Monetary Fund (IMF), etc...) and organizations looking to increase global equity and decrease poverty (United Nations (UN), UN Environmental Program (UNEP), etc...). Various researchers have concluded the potential negative impacts of global climate change will probably only intensify these disputes (Luterbacher and Norrlof 2001; Agarwal 2002; Baer 2002). The conflict between rich and poor even extends down to the individual level.

Two responses are often offered to counter the effects of global climate change, mitigation and adaptation, and both could impact all global citizens (Wilbanks et al. 2003). Global climate change mitigation involves “anthropogenic intervention to reduce the sources of greenhouse gases or to enhance greenhouse gas sinks” (IPCC WGIII, 2001, 3). For example, reduction of sea level rises through mitigation efforts will probably help protect the millions of poor people that live along coastlines worldwide. Globally, over 45 million people live in areas at risk from storm surges. A 1-1/2 foot rise in sea level will increase that risk by more than 90 million people and a 3-foot rise will put an additional 118 million people at risk (Willis 2002). Eleven of the 15 largest cities in the world lie along seacoasts or estuaries. Nicholls and Mimura (1998) estimate that 600 million people will live in coastal floodplains by 2100, consequently the risk from sea level rise is exponentially increasing.

Adaptation, the second method to counter the consequences of global climate change, is the ability to adjust to new climate circumstances and could be a necessary strategy by both rich and poor and must be used as a complement to mitigation efforts (IPCC WGII, 2001). Adaptation, however, entails large social, economic, and political costs and will not prevent all the array of negative problems created by global climate change (Wilbanks 2003). Wealth, technology, education, information, skills, infrastructure, access to resources, and management capabilities are all often monopolized by the rich and are the primary factors that determine adaptation to global climate change (IPCC WGII, 2001). Another viewpoint that energizes the rich-poor, North-South debate is the effects of the natural environment on politics.

In the past, geopolitical discussions sometimes focused on the effects of climate change and climatic fluctuations on the evolution of human society. In these discussions the performance of the West versus non-Western parts of the world were often explained as results of ecological and climatic factors (Deudney 1999). Theories of the European advantages in topography, climate, geography, and ecology imbued epidemiological, geographic, organizational, transportation, economic, and governmental advantages with the European societies and were used to explain their rise to world dominance (Diamond 1999). Concepts like “ecological imperialism” (Crosby 1986) and the “winter gap” (Mazrui 1986) may again become energized along with other geopolitical concepts that had been condemned to the political science graveyard of discarded theories as global climate change increases the size of the tropics, climate wise, worldwide (IPCC WGII, 2001).

Perhaps the most salient point of the conflict between the rich and poor is that the poor (poor states, non-state actors, and individuals) have the least capacity to adapt to global climate change and therefore are the most vulnerable (Gupta 2001; IPCC WGII, 2001; Agarwal 2002; Baer 2002). Whether the current imbalance between rich and poor is reduced by technology transfers and economic assistance or is intensified by global climate change policies that do not assist the poor, will determine where the new equilibrium point settles between rich and poor.

Conclusions

Changes to the Earth’s climate are forcing three disequilibria, three imbalances that will challenge human planning, creativity, and ingenuity. Strategies and plans to

counter global climate change must take into account the changes that will occur as the world shifts from one equilibrium point to another along these three dimensions.

Social, economic, political, and environmental balances will be affected by global climate change and a clear understanding of some of the challenges ahead require investigating, evaluating, and comprehending the four disequilibria created by the global climate change catalyst.

CHAPTER II

SELECTED LITERATURE REVIEW

Introduction

The disequilibrium in international relations resulting from the political, social, economic, and environmental effects of global climate change, could take on four possible dimensions. The first major dimension of international relations that may be impacted is the political discourse between the two dominant worldviews, realism and liberalism. The second major dimension of international relations that might be influenced by climate change is the social/environmental controversy between dominant social paradigms, those that are anthropocentrically focused and those that are ecocentrically aligned. The third important sector of international relations that could be pressured for realignment by climate change forces is the struggle between rich and poor and the economic paradigms that attempt to explain that struggle. The fourth and final dimension is the environmental domain and in particular the effect of global climate change on the environment and society. In particular, the environmental changes resulting from global climate change could be the catalyst for the paradigm changes offered above. Each dimension will receive a brief literature review to provide pertinent background material and to frame further discussions in a focused manner.

International Relations Paradigms – Introduction

The controversy between the realist and liberal paradigms parallels much of the storied history of political science in general and the study of international relations in particular. Scholars of international relations have traditionally focused on what Stephen Walt has described as a “protracted competition between the realist, liberal, and radical traditions” (Walt 1998). This dissertation will only explore in-depth the “protracted competition” between realist and liberal traditions and only briefly investigate the potential effects of the radical traditions.

Realism

In general, most realists thought in the past and today focuses on at least five core premises. First, many realists consider the central questions of international relations to be the causes of war and peace. Questions, for example, about the relative influence of the international political economy or the influence of norms, values, information, or ideas are always couched in respect to the primacy of their effect on conditions for war or peace (Holsti 1995; Seligson and Passé-Smith 1998).

Second, the basic structure of the international system is essentially anarchical, which infers that there is the absence of a central authority to settle international disputes (Waltz 1959; Hoffman 1965). States are also thought to inherently possess some offensive military capabilities, which make them potentially dangerous to each other (Mearsheimer 1994-1995; 2001). Consequently, anarchy and potentially dangerous states create a “self-help” environment where states have to look out for their own security and survival, an environment that often produces security dilemmas.

Third, geographically based city-states, or empires were and geographically based states are currently considered to be the central actors of the international system. Other international entities like international organizations (IOs), non-governmental organizations (NGOs), or multinational corporations (MNCs) are not considered the most important actors in international relations (Morgenthau 1978; Waltz 1979; Holsti 1995).

Fourth, states are considered as rational actors guided by logical “national interests” that are usually centered on state survival, security, or power. National interests are sometimes referred to as “states preferences” and are often considered to be fixed and uniformly conflictual (Powell 1994; Legro and Moravcsik 1999). Thus, states are assumed to think strategically about how they can survive in the international system (Mearsheimer 1994-1995; 2001) or how they can keep power, increase power, or demonstrate power (Morgenthau 1978). Consequently, realists believe that international relations are not progressive (Keohane 1989a), but are “repetitive or cyclical” (Zacher and Matthew 1995, 108).

Fifth and last, states are considered to be unitary actors. As unitary actors, states are mainly influenced by external, international forces and are less influenced by internal, domestic political forces (Krasner 1978; Holsti 1995). These core premises have often been updated and revised over the years.

Two prominent efforts to update realism with a more parsimonious and rigorous design have narrowed research attention to the structure of the international system. Kenneth Waltz’s book *Theory of International Politics* concentrated on the third level of analysis identified by Rousseau, the system level and became the basis for

neorealism. The other two levels were concerned with human nature (“first image”) and state attributes (“second image”) (Waltz 1959, 1979). In addition, Robert Gilpin’s *War and Change in World Politics* (1981) focused on the variations in change within the international system. Even though most realists would agree with these five core premises, classical realists do have a few major concepts that differ slightly from general modern realist theory.

Classical realists are also concerned with the condition of legal sovereignty, which describes the basis of a state’s authority over its territory and people and conversely, the absence of authority over territory, people, or events in other sovereign states (Snow 2000). Also, power for classical realists is the most important concept in international relations research (Morgenthau 1978; Dougherty and Pfaltzgraff 2001). More recent critiques of realism have also added additional depth and insight to modern realist theory.

Classical realism has been criticized because it is grounded in a pessimistic theory of human nature. According to classical realists, humans are basically egotistic and self-interested or as Charles Kegley states “sinful and wicked” (Kegley 1995, 5). This view has been criticized for considering human nature a constant, instead of a variable that could add explanatory power to the actions of major international relations actors (Holsti 1995; Dougherty and Pfaltzgraff 2001). Also, many critics deride the imprecision or contradictory nature of the core classical realist concepts of “power,” “national interest,” and “balance of power” (Claude 1962; Haas 1953; Holsti 1995; Dougherty and Pfaltzgraff 2001). In addition to the critiques of classical realism, modern realism has also received some harsh academic attacks.

Critics, via three primary complaints, have sharply challenged modern realism. First, realism has poor predictive powers. The end of the Cold War did not fit with realist theory because most realists did not anticipate the peaceful demise of the bipolar, global conflict between the Soviet Union and the United States and the ensuing spread of global cooperation and integration (Holsti 1995; Kegley 1995; Vasquez 1997; Dougherty and Pfaltzgraff 2001). Second, realism has poor descriptive power and does not always reflect reality (Vasquez 1993). For example, historian Paul Schroeder identifies numerous instances where states did not respond to threats to their survival by using the core realist concepts of self-help or power balancing (Schroeder 1994, 1994a; Vasquez 1997). Third, realism does not account for change adequately. Changes in the saliency of global issues like population growth, international trade, transboundary pollution, and global climate change have diverted decision-makers' attention away from balance of power concerns toward anxieties over globalization and global environmental change (Myers 1993a, 1993b; Gaddis 1992-1993; Kegley 1995). Neorealism, in particular, has been the object of heated and controversial debate and subsequent modification.

Critics of neorealism argued that Waltz's focus on the distribution of capabilities among the major actors only allows a general explanation of outcomes in international relations and ignores the political activities within states to the detriment of political activities between states (Holsti 1995). Specifically, some critics of neorealism have stressed the disregard for the impact of domestic politics and in particular, individuals on international relations, where an individual person "holds the potential to be the master of structures, not simply the object" (Dougherty and Pfaltzgraff 2001, 97).

Neorealism is also faulted for not focusing enough attention on the social aspects of power and too much attention on the role of the state-as-actor aspects of international relations (Dougherty and Pfaltzgraff 2001). However, recent work by realists has produced major works modifying and advancing neorealist thought.

Joseph Grieco's 1988 article, "Anarchy and the Limits of Cooperation: A Realist Critique," contested the explanatory power of neoliberal institutionalism versus the predictive capabilities of neorealism, (Grieco 1988; also see Baldwin 1993; Mearsheimer 1994-1995; Kegley 1995 for more on the neoliberal – neorealist controversy). Additionally, Robert Gilpin and Stephen Krasner investigated international regimes and found that their existence and activities could also be explained in realist terms (Gilpin 1975; Krasner 1976, 1983). Realism is not alone in attracting a wealth of academic and scholarly discussion and criticism. Liberalism too has a storied history that has lead to debate and critiques.

Liberalism

Early liberal thought was committed to a process of steady, perhaps uneven, growth in human freedom. Human freedom was and is assumed to be expanding due to the economic, social, and political policies and programs that emerge from democratization and market capitalism. This process is enabled, enhanced, and aided by human reason and technological developments (Zacher and Matthew 1995). Two important early variants of liberal thought were laissez-faire liberalism and democratic or interventionist liberalism (Zacher and Matthew 1995).

Laissez-faire liberalism was originally based on the political theory of John Locke and the economic theory of Adam Smith (Pease 2000). The basic premises were support for limited government based on the consent of the governed, emphasizing restrained interference in the private sector by the central governing forces. The state's primary functions were limited to "enforcing a minimal set of laws, adjudicating disputes, and defending property and individual rights, especially against foreign aggression" (Zacher and Matthew 1995, 111). Additionally, moral and ethical principles were assumed to operate independently and have little influence on political processes (Zacher and Matthew 1995).

The second variant, democratic or interventionist liberalism, espoused less optimism that limited government interventions into private activities would be beneficial to freedom and the welfare of individuals. Writers in the vein of Jean-Jacques Rousseau supported government activities in education and redistribution of wealth and power to overcome some of the negative effects of free markets and self-interested individuals (Rousseau 1968). However, both of these variants and most early liberal international relations scholars, obligated a more limited role for liberal values and ideas in the politics of international relations, where it was believed that both self-interest and power would dominate (Zacher and Matthew 1995). Yet, not all early theorists were as dour in their assumptions that liberal values, ideas, and theories did not apply to foreign policy and international relations.

Immanuel Kant, in a more optimistic view, foresaw the possibility of the interaction of republican states, international trade, and cosmopolitan law creating the right conditions for world peace. Specifically, he identified three principles of conflict

resolution applicable to global relations. The first principle involves “republican constitutions,” which are the heart of representative democracies that support and defend freedom, equality, and separation of power. The constitutions of the democratic states in turn create the moral base for the second principle of a “pacific union” of free states. The union of states is held together by international treaties, laws, and organizations, (cosmopolitan law) which further promote the third principle of “commerce and free trade.” Free international trade among democratic states ensures and enhances international ties, bound together not by force, threats, or coercion, but by economic incentives (Kant 2001; Russett and Oneal 2001, 29). Together, these three pillars encourage citizens to oppose war because of the dreadful costs in lives and resources (blood and treasure), to increase norms of cooperation and peaceful relations, and enable citizens and states to reach accommodations over a broad range of issues, without resorting to war and violence (Russett and Oneal 2001). The forces that would drive the creation of the three pillars have gradually evolved over time and have led to modification of liberal concepts and theories.

In the nineteenth century, liberal theorists like David Ricardo, James Mill, John Stuart Mill, Richard Cobden, Benjamin Constant, and Herbert Spencer all built upon Kant’s theory. Specifically, they looked at what would be the catalysts that would spark the creation of Kant’s pillars of peace. These modern theorists concluded that free trade operated best outside the public realm and consequently was dependent on a lack of governmental interference that only democratic regimes could ensure. Additionally, they ascertained that a robust private sector would be the “engine of human progress” that ultimately would yield global cooperation, prosperity, and peace, the expectant

products of free trade (Zacher and Matthew 1995, 114). Historical events and changes led modern liberal thinkers to slightly modify these views.

The end of World War II began a dark period for liberalism as a worldview and its relevance and validity were challenged and since the end of World War II until the end of the Cold War realism has been the dominant international relations worldview (Baldwin 1993a, Holsti 1995; Vasquez 1983; Dougherty and Pfaltzgraff 2001). Nevertheless, scholars of liberal theory were still able to broaden and deepen liberal concepts and principles.

After World War II liberal challenges to realism arose from many different sectors of political science. One example is David Mitrany's treatise (1966) on functionalism, where he argued that cooperation in technical venues was much easier to achieve than collaboration in political or security related areas and that once some cooperation had occurred, more cooperation would ensue, spilling-over into other non-technical, political, or security related arenas. These networks of cooperation would work together to make war highly unlikely by causing adjustments in loyalties that would enable national loyalties to be displaced by international loyalties (Mitrany 1966; Zacher and Matthew 1995). Ernst Haas's (1958) expanded Mitrany's initial functionalist concepts with his development of neofunctionalism through his studies of European integration during the 1950's. Neofunctionalists concluded that pressure for more cooperation and integration from labor unions, political parties, trade associations, or supranational bureaucracies (Grieco 1988) would spillover into other issue areas as civil societies' motivations are altered by the impacts of forces for institutional change (Haas 1958; Katzenstein, Keohane, and Krasner 1998). Liberal studies took another

unique turn during the 1960s and 1970s as investigations into transnational relations, linkage issues, regimes, and institutions began to dominate liberal research.

Robert Keohane and Joseph Nye's early work on interdependence became the cornerstone for neoliberal institutionalism concepts (Keohane and Nye 1972, 1977). Institutions, it was concluded, are able to reduce transaction costs, improve the quality or quantity of shared information, enable tradeoffs in different issue-areas, activate ethical concerns, and facilitate enforcement of agreements or compromises (Zacher and Matthew 1995). Institutions increased the level of interaction between states and consequently the level of interdependence. Liberals believe that the greater the levels of interdependence between states, the more international institutions there are, the greater the likelihood of peaceful cooperation (Keohane 1984; Russett, Oneal, and Davis 1998; Russett and Oneal 2001). Finally, recent work by John Oneal and Bruce Russett into the "liberal peace" among democracies (Oneal and Russett 1997, 2001; Russett and Oneal 2001) adds an extremely strong quantitative dimension to liberal theories and concepts that was previously mostly qualitative.

Social Paradigms – Introduction

Social studies have recently identified significant conflict between two major social paradigms (Steel, Clinton, and Lovrich 2003). The current dominant social paradigm is a product of the industrial era and is a major influence on the decision and policy-making of governments and citizens. This worldview is based on an anthropogenic approach to environmental policy and natural resource management that asserts the production of goods and services for human use and consumption is the

primary focus for activities involving the natural environment (Steel, Clinton, and Lovrich 2003). The dominant social paradigm emphasizes that the continued growth of the world economy is essential to decreasing global poverty, improving living conditions worldwide, and will eventually reduce the relative inequalities among states. In addition, technological innovation is viewed as the engine for further economic growth that will be demanded by increased global populations. In essence, the dominant social paradigm contends that advances in science and technology will always overcome shortages of natural resources, poverty, or environmental problems.

Furthermore, free, efficient markets, unburdened by government interferences, are also necessary prerequisites for unconstrained economic growth. Population growth is also essential to economic growth because it is the primary means to increase production and consumption. On the other hand, environmental protection is a secondary concern, resource scarcity an allocation problem, and everything, including the global commons, has a market value (Anderson and Leal 1999). As a consequence, the dominant social paradigm is a centralized, hierarchical approach to decision-making that relies on power politics, the market, and economic competition for new policies and procedures (Steel, Clinton, and Lovrich 2003). The core principles of the dominant social paradigm are expressed in a social environmental theory described as corporate environmentalism.

Corporate Environmentalism

Corporate environmentalism is a social response to increased public concern for the environment (Beder 1998; Perry and Singh 2001; Gibbs 2003). The fundamental

nature of corporate environmentalism is the espousal of environmentally benign or friendly practices and increased recognition of environmental duties by corporations and firms solely for strategic reasons (Perry and Singh 2001; Gibbs 2003). Business firms assume a green facade but do not reconcile environmental protection issues at the expense of profits, market shares, or economic growth (Beder 1998; Gibbs 2003). Also, the natural environment is considered resilient and indestructible consequently corporate activities will not have permanent or irreversible impacts (Bailey 1993; Simon 1996; Lomborg 2001).

The response by many multi-national corporations to global concern for environmental protection is to incorporate activities such as pollution reduction procedures, decreased resource-intensity methods, environmental management systems, and environmental auditing. These efforts have successfully reduced some forms of pollution, waste, and improved some indicators of environmental. In essence, corporations are strategically integrating environmentally friendly procedures and processes primarily to enhance their public image and perhaps with a tertiary concern for being a responsible member of society (Beder 1998; Rondinelli and Berry 2000; Perry and Singh 2001; Gibbs 2003). However, a challenger has emerged recently to the dominant social paradigm, the new environmental paradigm.

New Environmental Paradigm

The new environmental paradigm envisions a totally different theoretical approach to environmental problems and issues than the approach supported by the dominant social paradigm. The new paradigm offers a biocentric method for the

management of environment and natural resources. Accordingly, the focus is on environmental protection, concern for future generations, population control, and sustainable development. The new paradigm stresses the dangers of relying too heavily on technological innovations to cure all problems and encourages a more consultative, participatory, decentralized decision and policy-making process (Steel, Clinton, and Lovrich 2003). Subsequently, the new environmental paradigm has become embodied by two major social concepts, ecological modernization and radical environmentalism.

Sociologists in the late 1980s were becoming increasingly concerned with the new, growing dimensions of contemporary environmental problems. Global environmental change was emerging as a physical and social threat to natural and human systems. The threats were determined to be anthropogenic in origin, socially constructed, global in scale, uneven in impact, often interest based, dominated by experts and expert systems, had ethical dimensions, and eventually could negatively impact human and natural ecosystem survival (Blowers 1997).

Ecological modernization theory emerged in the 1980s and has become “in a remarkably short time a well-established set of ideas, founded in general social theory and supported by a growing number of case studies” (Mol and Spaargaren 2000, 17). Joseph Huber (1982) first asserted the desirability and possibility of a green form of capitalism when he introduced the basic premises of ecological modernization theory. Early ecological modernization principles were heavily dependent on the use of technological innovations to correct environmental problems and mistakes. Additionally, early efforts began to focus on the role of market actors, the dynamics of ecological systems, and the evolutionary character of social/environmental problems

(Mol 1996; Mol and Sonnenfeld 2000). In the late 1980s and mid-1990s, ecological modernization concepts became less reliant and focused on technological innovation as a force for environmental reform and became more balanced. Advocates now supported using the powers of state institutions and the market to drive ecological transformation in conjunction with technological advancements (Mol 1996; Mol and Sonnenfeld 2000). Also, ecological modernization theory emphasizes that environmental protection and economic well-being are necessary and very compatible (Mol 1996; Crowley 1999; Toke 2001). The core premise of ecological modernization is the transformation of political, social, and environmental institutions in ways that permit reconciliation of the economic and environmental spheres of society through the establishment of policies and programs that equitably protect the global sustenance base (Mol 1996; Mol and Sonnenfeld 2000; Curran 2001; Mol 2002).

Many of the developmental efforts by advocates of ecological modernization were in direct response to what was considered the failings of the two dominant radical schools of thought in the 1970s and 1980s: the counter-productivity or de-industrialization school and the neo-Marxists camp (Mol and Spaargaren 2000; Mol 2002). In particular, radical environmental change advocates argued that many ecological modernization concepts directly challenged many of the core premises offered by the de-modernization supporters and the anti-capitalist neo-Marxists.

De-industrialization advocates were confounded by the increasing degradation of the global environment and the inequalities created by modern production and consumption processes and reacted by promoting a fundamental reorganization of the major capitalist institutions of modern society with the aim to decentralize production,

to reduce resource exploitation and waste, and to place contemporary economies on a path to sustainable development (Mol and Spaargaren 2000). Ecological modernization supporters acknowledged early theoretical deficiencies that contributed to environmental destruction and worked to repair design faults but have consistently disagreed with de-industrialization advocates that the present production and consumption institutions had to be replaced before sustainable development was achievable (Mol and Spaargaren 2000). Early de-modernization critics of ecological modernization theory challenged the theories' reliance on technological solutions to remedy global environmental problems (technological optimism). As a result ecological modernization researchers have attempted to modify principles and concepts to reflect a more prudent and circumstantial dependence on technology.

In addition, ecological modernization supporters advocate a more proactive technological focus by incorporating environmental objectives at the beginning of technological planning processes instead of reactively at the end. Over time the de-industrialization perspective lost its appeal as ecological modernization concepts were modified and refined (Mol and Spaargaren 2000). The second and more persistent challenger to ecological modernization theories came from the radical neo-Marxists.

Neo-Marxists have critiqued ecological modernization from its theoretical beginnings (Mol and Spaargaren 2000; Mol 2002). Ecologically sound capitalism has been repudiated by a variety of researchers advocating a more radical transformation of global capitalism (Pepper 1984; O'Connor 1991, 1996; Schnaiberg and Gould 1994; Pellow, Schnaiberg, and Weinberg 2000; Spence 2000). Neo-Marxist supporters of radical environmentalism argue capitalism is the primary source of ongoing

international social inequalities and global ecological devastation (Mol 2002). Radical environmentalists contend the only sensible path to a sustainable and equitable society is by replacing capitalism with a more socialist and environmentally conscious economic system (Pepper 1984; O'Connor 1991, 1996).

One radical critique contends that the current economic system violates the second contradiction of capitalism, which argues economic growth driven by the global capitalist system will soon encounter environmental barriers to capital accumulation (Pepper 1984; O'Connor 1991, 1996; Mol 2002). In the end, radicals contend the second contradiction will force the formation of new social/environmental movements that will be the agents of progressive social and ecological change (O'Connor 1991, 1996; Spence 2000).

A second radical assessment argues capitalism creates a treadmill like production and consumption logic that is incapable of stopping to consider or adapt to ecological limits to production or consumption (Schnaiberg and Gould 1994; Pellow, Schnaiberg, and Weinberg 2000). Market forces are even applied to common public goods such as clean air, land, and water in an attempt to maximize exploitation of international natural resources in an out-of-control, highly competitive, global economy (Schnaiberg and Gould 1994; Pellow, Schnaiberg, and Weinberg 2000).

Ecological modernization supporters respond to radical critiques by asserting that any mode of production and consumption can be reformed or transformed to become environmentally cognizant and responsive. Additionally, capitalism is not a static system and is constantly changing and being changed by a variety of external and internal influences (Mol and Spaargaren 2000). However, neo-Marxists critiques in

relation to interest group power struggles and to normative, ethical, and equitable debates are still considered valid and in need of further research by ecological modernization scholars (Mol and Spaargaren 2000).

Economic Paradigms – Introduction

Economic forces are powerful influences on society and politics (Gilpin 1987) and also exert great pressures on the natural environment (Costanza et al. 1997). Until recently economists did not interact much with environmental or natural scientists and were mainly concerned with resource flows and prices. Today, economists and ecologists are working together to understand the interactions between the natural world and the financial/economic world. The traditional school for economics has been updated and now is often referred to as neo-classical economics. The newest field in economics that attempts to merge economic and environmental concerns is ecological economics. Accordingly, the relationship between the dominant paradigm, neo-classical economics and ecological economics may soon be pressured by the impacts of global climate change

Neo-Classical Economics

Neo-classical economics have been the dominant economic paradigm since the early 1870s. Based on mathematical principles grounded in physics, neo-classical economists attempted to model human economic activities and processes by applying cause-and-effect formulas (Norgaard 2000). In environmental issues this form of mainstream economics concentrates on relative scarcity, allocation of scarce resources,

and optimal welfare considerations. Neo-classical economists judge environmental degradation problems to be simply an allocation problem (Mulder and Van Den Bergh 2001). Finally, neo-classical economic concepts have also been influenced by certain political and scientific theories that have contributed to a main neo-classical theoretical emphasis.

Firms and individual households are the major objects of analysis for neo-classical economists as they measure and calculate the supply and demand market forces that influence the profit or utility maximization efforts of those same firms and individuals (Frieden and Lake 1996; Soderbaum 2000; Muller 2001). Rational cost-benefit analysis across a wide range of possible market interactions reflects the typical behavior by most market actors (Frieden and Lake 1996; Muller 2001). Market actors are also assumed to possess perfect information about market options and their impacts (Soderbaum 2000). Neo-classical economics also relies on certain other liberal economic assumptions such as the economic efficiency created by limited government intervention in the economy (Hayek 1960; Mitchell and Simmons 1994; Frieden and Lake 1996; Lobao and Hooks 2003). Specifically, the “invisible hand” assumption by Adam Smith regulates the voluntary exchanges in a market place free from government interventions as a result the market is considered the most efficient and effective allocator of scarce goods and services (Smith 1937; Frieden and Lake 1996; Muller 2001). In essence, neo-classical economists “assume that society is simply the sum of its individuals, the social good is the sum of individual wants, and markets automatically guide individual behavior to the common good” (Costanza et al. 1997, 24).

The inability of neo-classical economists to value certain common goods or public services led to the development of the theory of external effects and public goods (Pigou 1920; Muller 2001). Neo-classical economists study how to maximize social optimums by incorporating externalities into market economy operations. Accounting for externalities requires monetary valuation of the external costs or benefits (Freeman 1993). In particular, the conventional economic approach has been also been criticized as being unable to identify transition paths to sustainable development (Mulder and Van Den Bergh 2001). Interestingly, neo-classical economists have also been accused of relying too heavily on the power of human ingenuity and technology to correct market imperfections, industrial mistakes, and to overcome natural resource limitations (Costanza et al. 1997; Costanza 2001).

Neo-classical economists believe innovation and diffusion of technological improvements are the driving forces of continued economic growth but are considered exogenous to general economic processes (Mulder and Van Den Bergh 2001). The fundamental concept that neo-classical economists stress is that economic growth is the solution to all problems: poverty, environmental degradation, and even global climate change (Nordhaus 1994; Costanza et al. 1997; Soderbaum 2000; Toman 2001). Ecological economics, a very recent challenger to neo-classical economics, seeks to correct many of the perceived deficiencies of conventional economics.

Ecological Economics

Ecological economics arose as an academic discipline in the mid-1980s as an alternative to neo-classical economics. The new discipline no longer accepted that

ecology was but one of several environmental and resource economic considerations, consequently an extended effort was made to incorporate ecology and many other academic disciplines into economics, creating a transdisciplinary approach (Costanza et al. 1997; Masood and Garwin 1998; Soderbaum 2000). Many ecological economists concur with neo-classical economists that placing a financial value on environmental goods and services is an appropriate way to focus needed public scrutiny on the importance of environmental protection but many other ecological economists disagree on the valuation process and some do not believe that it is possible to value things like a species, waterfalls, or clean air (Mulder and Van Den Bergh 2001; Muller 2001). Additionally, there are currently no markets for many environmental goods and services and the physical nature of many natural resources precludes accurate and unbiased valuation or the assignment of private property rights (Dasgupta, Levin, and Lubchenco 2000).

The field of ecological economics is also considered a more pragmatically and ecologically grounded substitute for neo-classical economics, a field that is purportedly overly obsessed with mathematical formulations and calculations (Masood and Garwin 1998; Soderbaum 2000). Ecological economics is also deemed as a political effort to give more research agenda setting and policy-making influence to ecologists investigating environmental/economic issues. This effort has brought to the forefront many controversial economic and ecological problems such as how to measure the limits and constraints to ecosystem goods and services (Daly 1993; Malcolm and Pitelka 2000; Poff, Brinson, and Day 2002), how to develop market-based incentives to help conserve natural resources (Costanza et al. 1997; Peterson, Dudek, and Goffman

1998; Edmonds et al. 1999), how to quantify the value of ecosystem goods and services and natural global capital (Costanza et al. 1997; Dasgupta, Levin, and Lubchenco 2000), and how to define the economic features of sustainable development (Costanza et al. 1997; Masood and Garwin 1998; Dasgupta, Levin, and Lubchenco 2000). Core ecological economic actors and processes adhere to a few primary concepts that make the emphasis of this discipline unique from conventional economics.

The major focal point of ecological economics is the equitable distribution of resources and property rights, between humans and other species, now and in the future (Costanza et al. 1997; Masood and Garwin 1998). Admittedly, this pluralistic approach is based on liberal neo-economic models of the individual as rational utility maximizers (Frieden and Lake 1996; Muller 2001) and on the efficient allocation properties of free markets (Costanza et al. 1997). However, the pluralistic concepts are also based on a neo-marxist economics principles where the concern for community rights and recognition of the negative effects of power differentials on the past, present, and future allocation of natural resources and common goods and services are additional pertinent decision-making factors (Costanza et al. 1997; O'Connor 1991, 1996, 1998; Pellow, Schnaiberg, and Weinberg 2000).

Ecological economists envision a larger, more expansive activist role for government in market operations than do neo-classical economists (Mol 1996; Blowers 1997; Costanza et al. 1997; Soderbaum 2000; Muller 2001; Toke 2001; Mol 2002). They also differ in their inclusion of equity considerations when calculations of fair distribution and sustainable scale are made concerning environmental problems

(Costanza et al. 1997; Claussen and McNeilly 2000; Howarth 2000; Cazorla and Toman 2001; Mulder and Van Den Bergh 2001; Roberts 2001; Wiegandt 2001; Agarwal 2002; Baer 2002; Ashton and Wang 2003).

Ecological economics is an extension of neo-classical economics that attempts to correct some of the limitations observed in neo-classical economics (Costanza et al. 1997; Soderbaum 2000; Mulder and Van Den Bergh 2001). Additionally, uncertainty, market failures, and the difficulty in arriving at consensus on the discount rates for future costs or benefits of goods and services are major concerns and research topics for ecological economists (Costanza et al. 1997; Dasgupta, Levin, and Lubchenco 2000; Mulder and Van Den Bergh 2001; Newell and Pizer 2001).

As a response, ecological economics offers an evolutionary framework that accepts uncertainty as a variable with stochastic, non-linear, self-organizing, and bounded rationality characteristics (Mulder and Van Den Bergh 2001). Ecological economists accept the complex features of environmental change and understand that biogeochemical processes that affect ecosystems and human systems are the result of dynamic feedback processes that are often multi-directional and sometimes irreversible (Costanza et al. 1997; Mulder and Van Den Bergh 2001). From this evolutionary process the concept of sustainable development has evolved as the main focal point of ecological economics.

Integrating the physical environment into the economic system has revealed that the scope, magnitude, and direction of global environmental changes are exceeding the carrying capacity of the Earth's life-support systems (Arrow et al. 1995; Vitousek and Mooney 1997; Dasgupta, Levin, and Lubchenco 2000). Ecological economists offer the

concept of sustainable development, a focused economic development approach that is consistent with long-term environmental quality and resource availability, as an ecological-economic alternative to continued economic growth (Costanza et al. 1997, 2000; Mulder and Van Den Bergh 2001). Sustainable development balances the concerns for intra and intergenerational equity and the rights of future human generations with the need to protect and preserve natural capital stocks from irreversible destruction (Costanza et al. 1997; Dasgupta, Levin, and Lubchenco 2000; Mulder and Van Den Bergh 2001). Consequently, ecological economics is all about the development of an economic system on a sustainable scale that operates within natural ecological limits (Costanza et al. 1997).

Global Climate Change – Introduction

The current literature on global climate change is enormous and comprehensive. Only the areas that are relevant to this dissertation will be reviewed briefly. Additionally, the history of climate change negotiations and the scientific studies underpinning the negotiations has been the subject of many researchers and is pertinent to this study. Also, a brief introduction into the political, social, economic, and ecological aspects of climate change will preface a deeper investigation of global warming controversies in ensuing chapters.

The history of the global climate change regime has revealed the evolution of what was once an uncertain scientific phenomenon into a highly contentious international relations issue (Bodansky 2001; Luterbacher and Sprinz 2001; Schneider and Kuntz-Duriseti 2002). Also, the enormous scientific research efforts concerning

global climate change has been thoroughly chronicled by the Intergovernmental Panel on Climate Change (IPCC) in a series of major reports released in 1990, 1995, and 2001. In addition, the US National Academy of Science has produced a comprehensive scientific report on the potential consequences of climate change on the United States (NAST 2000). As mentioned earlier, global climate change has evolved from primarily a theoretical scientific concern into an international relations political quandary.

Political Consequences

The politics of climate change come in the two expected domains, domestic and international. The examinations of the domestic political features of climate change have explored the large variety of domestic actors that are involved in climate change issues (Agrawala and Andresen 1999; McCright and Dunlap 2000, 2003; Raustiala 2001; Sprinz and Weiss 2001), the unique characteristics of the US climate change policy debate (Anderson 2002; Rosencranz 2002), and the impacts of climate change on democracy (Holden 2002).

Internationally, climate change researchers have investigated the role of states and non-state actors in climate change negotiations (Raustiala 2001; Rowlands 2001), the various policy approaches to reducing global greenhouse gas emissions (Kolstad 1996; Wigley, Richels, and Edmonds 1996; Manne and Richels 1997; Schelling 1997, 2002; Petsonk, Dudek, and Goffman 1998; Edmonds et al. 1999; Fischer, Kerr, and Toman 2001; Nordhaus 2001; Pizer 2001; Shogren and Toman 2001; Toman 2001, 2001a, 2001b; Wiener 2001; Goulder and Nadreau 2002; Aldy et al. 2003), and the need to entice developing countries into a global climate regime (Bernstein et al. 1999;

Cazorla and Toman 2001; Mitchell 2001; Paterson 2001; Wiegandt 2001; Agarwal 2002; Baer 2002). The social dimension of climate change is as equally robust as the political domain.

Social Consequences

Socially, the impacts of climate change are broad in scope and magnitude. Researchers have explored the effects of climate change on human health (Moore 1998; Balbus and Wilson 2000; Burtraw and Toman 2001) and on the implied changes needed for communities dependent on fossil fuel industries (Greenwald, Roberts, and Reamer 2001). Accordingly, the policy impacts of climate change legislations will create multiple crosscutting forces in society and soliciting compliance from producers and consumers to climate change policies can be complex and difficult (Petsonk, Dudek, and Goffman 1998; Dannenmaier and Cohen 2000; Bodansky 2001; Mitchell 2001; Wiener 2001, 2002). In particular, climate change will also influence consumer energy choices in the near future and the role of renewable energy sources and energy conservation could change dramatically (Hawken, Lovins, and Lovins 1999; Darmstadter 2001; Jaffe, Newell, and Stavins 2001; Berger 2002). In addition, the policies generated by climate change negotiations are predicted to influence technological innovation in a global manner (Goulder and Schneider 1999; Hawken, Lovins, and Lovins 1999; Edmonds, Roop, and Scott 2000; Sanstad 1999, 2000; Margolis and Kammen 2002; Smith et al. 2002). No less important than the social impacts of global warming are the far-reaching economic consequences of climate change.

Economic Consequences

Economic studies of the consequences of global climate change have also been controversial, informative, and expansive. Various studies have analyzed the costs of reducing emissions (Kolstad 1996; Wigley, Richels, and Edmonds 1996; Manne and Richels 1997; Schelling 1997, 2002; Peterson, Dudek, and Goffman 1998; Edmonds et al. 1999; Fischer, Kerr, and Toman 2001; Pizer 2001; Nordhaus 2001; Shogren and Toman 2001, 2001a, 2001b; Wiener 2001; Goulder and Nadeau 2002; Aldy et al. 2003), the benefits of reducing emissions (Burtraw and Toman 2001; Bernow et al. 2002; Schneider and Kuntz-Duriseti 2002), and the powerful influence of equity in global climate change negotiations (Claussen and McNeilly 2000; Howarth 2000; Cazorla and Toman 2001; Kerr 2001; Luterbacher and Sprinz 2001; Paterson 2001; Wiegandt 2001; Agarwal 2002; Baer 2002; Holden 2002; Wolfson and Schneider 2002; Ashton and Wang 2003). Interestingly, economic considerations of the impacts of climate change are increasingly including the environmental consequences of global warming.

Environmental Consequences

The environmental effects of global warming are substantial, diverse, and complicated. Global warming, to various extents, could impact all major global ecosystems. Specifically, the biodiversity of terrestrial ecosystems will be significantly affected by climate change (Malcolm and Pitelka 2000; Root and Schneider 2002; Parmesan and Yohe 2003; Pugh 2003; Root et al. 2003), increases in sea levels and global temperatures as a result of global warming will also change the nature and

structure of aquatic ecosystems worldwide (Poff, Brinson, and Day 2002), and negatively impact global coastlines (Neumann, Yohe, and Nicholls 2000). Additionally, international water resources will be directly affected by global climate change (Frederick and Gleick 1999; Neumann, Yohe, and Nicholls 2000). Also, climate change will also influence various land uses to include agriculture (Adams, Hurd, and Reilly 1999; Schlamadinger and Marland 2000; Pearson 2002) and forest management (Schlamadinger and Marland 2000; Niles 2002).

In sum global climate change could have enormous impact on the political, social, economic and environmental processes, paradigms, and institutions around the world.

CHAPTER III

DISEQUILIBRIUM BETWEEN INTERNATIONAL RELATIONS WORLDVIEWS

Introduction

The disequilibrium between the dominant worldviews of realism and liberalism is a portent of a shift in dominant political science paradigms. Normal science has been described as “research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its further practice” (Kuhn 1962, 10). Scientific revolutions, on the other hand, have been envisioned as “the tradition-shattering complements to the tradition-bound activity of normal science” (Kuhn 1962, 6). They have also been described as “a non-cumulative developmental episode in which an older paradigm is replaced in whole or in part by an incompatible new one (Kuhn 1962, 92). When a paradigm shift takes place, “a scientist's world is qualitatively transformed [and] quantitatively enriched by fundamental novelties of either fact or theory” (Kuhn 1962, 7). When the existing rules of the dominant paradigm cease to answer the puzzles that emerge, when there are observed discrepancies between theory and fact, a crisis occurs in the scientific community (Kuhn 1962, 68-69). “Paradigm shifts not only result from intellectual exposure of the limitations of the dominant paradigm, but these paradigmatic revolutions also emerge and are energized by transformations in world politics” (Kegley 1993, 132).

In particular, some scholars have noted, “times of turbulent change are catalysts to the reconstruction of theories—to new thinking and new paradigms” (Ferguson and Mansbach 1988; Kegley 1993, 131). Dramatic, turbulent changes in world events, wars and revolutions, have often impacted the confidence scholars have in the dominant paradigm’s usefulness and often coincided with shifts in a paradigm’s influence (Kegley 1993). Paradigm shifts have occurred following the Peace of Westphalia in 1648 (the end of the Thirty Year’s War), when the Congress of Vienna was established in 1815 (the end of the Napoleonic Wars), with the birth of the League of Nations in 1919 (the end of World War I), and with the emergence of the United Nations in 1945 (the end of World War II) (Kegley 1993). A cataclysm of similar proportions may be on the horizon, in the guise of global climate change, and another great paradigm shift an eventuality.

Global climate change could have profound impacts on the social, political, economic, and environmental conventions and institutions that currently shape the world. Unprecedented ecological and societal hazards and risks to the well-being of humankind are notable potential features of global climate change (Holden 2002). A significant shift away from using fossil fuels as the immediate energy source of the global economy will place unaccustomed constraints on and offer unprecedented choices for global society that will affect the goals and objectives of people in every state on the planet (Toman 2001). As a result, climate change and responses to climate change could shake the very core assumptions that the present dominant paradigms are

based on and may instigate a reordering, a reconstruction, and a revision of international relations worldviews. The theoretical propositions that will specifically be investigated are:

1. The realist worldview is more applicable to global climate change discussions, responses, and solutions than the liberal paradigm.
2. The liberal worldview is more applicable to global climate change discussions, responses, and solutions than the realist paradigm.

In order to explore these propositions, each of the dominant paradigms must be eviscerated, the core assumptions examined, and their applicability to the climate change debate determined.

Central to the debates involving realism and liberalism are certain core assumptions. Core assumptions are the results of many years of distillation of a theory's essence using historical facts, empirical evidence, and constant reformulations that eventually result in the boundaries of a scientific discipline (Kuhn 1962). The core assumptions of a paradigm create "an implicit body of intertwined theoretical and methodological beliefs that permit selection, evaluation, and criticism" (Kuhn 1962, 16-17). Below is a table reflecting the central characteristics of the two major worldviews:

Table 2. Core Assumptions of Current Dominant Worldviews (Modified from Holsti 1995 and Hughes 1997)

Characteristics	Realism	Liberalism
Key actors	Geographically based units (tribes, city-states, and nation-states, etc.)	Highly permeable nation-states <i>plus</i> a broad range of non-state actors, including IOs, IGOs, NGOs, and individuals
Central motivations	Security Power Autonomy Status quo	Freedom Economic well-being Progress

Central problems	Causes of war Conditions of peace	Broad agendas of social, economic, and environmental issues arising from gap between demands and resources
Conception of current international system	Structural anarchy	Global society Significant influence by Kantian variables

The worldview core assumptions identified in Table 2 will be used as the basis to determine which assumptions of the dominant international relations worldviews are most applicable to the climate change debate. Each supposition will be compared individually to determine how it may be applied to climate change impacts, issues, and potential policy responses.

In general, realists assume that environmental issues like biodiversity, deforestation, and climate change are “low politics” and are not worthy of the “high” position awarded to security and power politics (Pease 2000). Also, realists focus on certain near-term anarchical threats to security, power, and autonomy and may not see the urgency for action that liberals argue are necessary to deal with the more uncertain, progressive, and long-term issues surrounding climate change. In addition, realists argue that “free-riding” by some states is too easy and highly likely given the current state of the global environmental regime. Given the low probability of global cooperation realists focus on national interests instead of global interests and are determined to prevent a loss of sovereignty they contend would accompany a weak climate change regime (Pease 2000). The rewards from a global climate change regime maybe too unclear for most realists to accept and therefore their participation in crafting an effective regime could be doubtful.

Liberals approach climate change from two angles. First, liberals assert climate change has inherent economic implications (discussed more thoroughly in Chapter V) and second these implications can only be addressed with an international response by governments and international organizations. Liberals argue that freedom and well-being can be protected and enhanced using flexible market mechanisms that would be institutionalized in a strong, diverse, and centralized global climate change regime (Pease 2000). The market, the state, and many non-state actors could have prominent roles in a global, liberal climate change regime.

Overall, the worldview that is most theoretically applicable to and credible in the global climate change debate should eventually dominate international relations study on this subject. Rationale for this central premise will become clear as the dominant worldviews are put into practical use through examinations, examples, and case illustrations of the worldview core assumptions.

Key Actors – Introduction

The first worldview assumption where realists and liberals differ involves the key actors that proponents of each paradigm identify as essential. Realists contend that geographically based units (tribes, city-states, and nation-states) have been the main actors on the international stage (Waltz 1979). Liberals, on the other hand see a more diverse troupe of actors on the international stage. A broad range of actors including easily penetrated states, intergovernmental organizations, and other non-state actors such as international organizations (IOs), nongovernmental organizations (NGOs), multi-national corporations (MNCs), and even groups or individuals are attended to by

the liberal perspective (Holsti 1995). The differences between the two proposals again can be illustrated using disputes and discussions that involve the global climate change debate.

Key Realist Actors and Global Climate Change

Realists affirm a state-centric view of international relations that concentrates on the activities of countries and their governments. Although they recognize that other entities can influence the international system, states are considered the principal actors, states are considered to be rational, and states pursue national state interests in a logical manner (Dougherty and Pfaltzgraff 2001; Wolf 2001). Again, the primary national interests of rational, unitary states are security, power, and autonomy (Hughes 1997). In the climate change context states would be assumed to pursue international agreements that reflect their national interests (Grieco 1988). An example of a state rationally pursuing its national interest in the climate change context would be Australia.

States

Australian political leaders have stated that they will not ratify the Kyoto Protocol because of economic concerns and because they are concerned that developing countries are not currently obligated to targeted reductions in greenhouse gas emissions (UNFCCC 1997; Papadakis 2002). Australian leaders are also aware that without ratification by the US there is little chance that the Protocol will succeed (Papadakis 2002). At first glance, Australian concerns seem misplaced. Under the Protocol,

Australia was required to reduce its greenhouse emissions to 108% of its 1990 levels (UNFCCC 1997). This strange arrangement whereby Australia can actually *increase* its emissions exemplifies how national interests sometimes overcome global necessity. However, a closer look at the structure of the Australian economy reveals where national interest concerns are originating. Australia is the world's largest exporter of coal, a major source of greenhouse gases when burned. What is also unusual is that Australia has the highest per capita greenhouse gas emissions of any OECD state (Papadakis 2002). Australian anxieties over job losses and decreased trade have overcome, at least temporarily, any concerns that Australians have for deleterious impacts climate change will have on Australia or some of her island neighbors. The focus is also on abatement costs and less on Australia's ecological vulnerability to climate induced changes (Sprinz and Weiss 2001). It would appear that Australian uneasiness over any degradation to their security, power, or autonomy is driving their climate change negotiations. Another example of an interest based explanation for international environmental policy comes from India.

India is often included among the group of developing countries (along with China and Brazil) who are expected to have substantial growth in greenhouse gas emissions in the future. Their growth is the reason countries like the US and Australia, often cite as the reason why the Kyoto Protocol is "fatally flawed" without inclusion of emission reduction targets for developing countries (Bush 2001b; Sprinz and Weiss 2001). India, in particular is projected to be extremely vulnerable to climate change, especially from sea level rise and from possible climatic shifts in the annual monsoon cycles that could devastate agricultural productivity. The agriculture sector produces

approximately 30% of India's gross domestic product and employees around two-thirds of the work force (IPCC WG II, 2001; Sprinz and Weiss 2001). Because of India's high level of environmental vulnerability and high abatement costs, this developing state should be a global leader in creating progressive climate change policies.

However, Indian national interests are focused on other troubling issues.

India contends that more immediate concerns such as public health, economic growth, and poverty alleviation are more pressing than global environmental problems like climate change (Sprinz and Weiss 2001). Also, efforts by the IPCC and the UNFCCC are looked upon with great suspicion by Indian leaders as attempts by the North to hold back Southern development by limiting their energy use (Paterson and Grubb 1992; Agarwal 2002). India and most developing countries see climate change as a Northern issue that the industrialized states created and the industrialized states should take the lead in remedial actions (Paterson and Grubb 1992; Wiegandt 2001; Baer 2002; Agarwal 2002). The Southern perspective considers the Kyoto Protocol "flawed at multiple levels" because it "may re-entrench the carbon-based energy infrastructure on a global level and perpetuate inequity between industrialized and developing countries" (Agarwal 2002, 375). Yet, India has ratified the Kyoto Protocol conforming to its national interests.

Climate change is not a pressing issue for developing states compared to poverty, development, or job creation. In contrast it is viewed as an opportunity for developing countries like India to improve their economic positions. Developing states want to gain access to substantial transfers of finance and technology via global emissions trading regimes, equitable entitlements to emissions, and carbon-free

technology transfers, which from their perspective is a way to catch up with the North, in a climate friendly way (Paterson and Grubb 1992; Agarwal 2002). Consequently for realists and for many state leaders, its all about state-centric interests, power, security, and autonomy. Nevertheless, liberals hear other voices battling to be heard from during the climate change debate.

Key Liberal Actors and Global Climate Change

Liberals want inputs from state actors *and* from non-state actors. Liberals focus on the influences and impacts of intergovernmental organizations like the United Nations (UN) and for climate change issues, subsidiaries of the UN, the World Meteorological Organization (WMO), the UN Environmental Program (UNEP), and the Intergovernmental Panel on Climate Change (IPCC). Other non-state actors involved in climate change discussions include non-governmental organizations (NGOs) like the World Wide Fund for Nature (WWF), the Pew Center on Global Climate Change, or the American Petroleum Institute. In addition, non-state actors like multinational corporations (MNCs) are also thought to have great influence on discussions concerning changing global climate. Even epistemic communities and individuals have been important actors in the climate change debate as their efforts to frame the climate change debate to suit their interests has had global implications (Skolnikoff 1999). The effects of each of these actors and others indicate that global climate change may not be solely a state-centric issue, dominated by national interests.

Intergovernmental Organizations

The climate change issue first developed within the scientific arena as researchers were encountering evidence that increasing concentrations of greenhouse gases in the atmosphere could change the global climate. Even though initially many scientific uncertainties abounded, a small group of Western scientists pushed the climate change issue onto the global agenda (Bodansky 2001). These scientists had close ties to both the WMO and UNEP and by publicizing current knowledge of the greenhouse effect they were able to attract the attention of national policy makers and citizens. In addition, dramatic environmental events like the discovery of the Antarctic ozone hole and the record setting drought and heat wave in the US in 1988 enabled climate change interests to reach global prominence and become an intergovernmental issue (Bodansky 2001). As a result, the UN working through the WMO and the UNEP established the IPCC in 1988. The IPCC was established to “assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation” (IPCC 1998, 1). In addition to these major intergovernmental actors, the climate change issue has attracted many non-state actors.

Non-State Organizations

Several non-state actors actively participate in the international climate change proceedings. They are involved in the meetings of the parties: they lobby governments, prepare policy statements, advise governments, fund research, and lobby the public and media. Importantly, non-state actors have had a significant affect on the “terms and

legal structure of the international climate regime” (Raustiala 2001, 96). Three major groups of climate change non-state actors have been identified: NGOs, “epistemic” or expert/scientific communities, and individuals (Raustiala 2001).

Non-Governmental Organizations

The NGO community that is involved in climate negotiations is made up of environmental, business, and trade organizations. Each community brings diverse and sometimes conflicting agendas to the climate change discussions. As climate change negotiations have matured and become more complex and specific, many new actors that have tangible stakes in the process outcomes have become involved. Issues such as implementation, commitments, and mitigation or adaptation costs are now very contentious as is the basic process of setting global greenhouse gas emission reduction standards. As a result, a plethora of new NGOs have become heavily engaged in the climate change negotiation process (Raustiala 2001).

The environmental NGOs have varied and sometimes conflicting agendas. Some focus on the effects of climate change on development and poverty, while others focus on biodiversity and ecosystem impacts. Additionally, the politics of climate change processes sometimes pits one environmental NGO against another (Raustiala 2001). Another very diverse community of climate change NGOs is the business NGOs.

The business NGOs are chiefly from the fossil fuel, automobile, insurance, power generation, and alternative energy supplier (solar, wind, hydrogen, geothermal, hydroelectric, nuclear) industries and multi-national corporations (Raustiala 2001). As

stated before, as the enormous potential costs of regulatory policies emanating from the Kyoto Protocol became better understood the number of business NGOs involved exploded. As a result, many very powerful and influential MNCs that make up the majority of transportation, energy, and agriculture industries have become involved in climate change negotiations.

The carbon-intensive industries, like transportation and energy, have vigorously fought against imposition of irrevocable greenhouse gas emission-reduction targets. Conversely, carbon-free industries such as solar, wind, nuclear, and hydrogen have just as vigorously supported imposition of legally binding emission-reduction targets (Raustiala 2001). The last category of NGOs reviewed are trade NGOs, a sometimes unusual and unexpected special interest representative.

The trades NGOs interested in climate change include diverse actors like the AFL-CIO, the Uranium Institute, the National Association of State Fire Marshalls, the International Solar Car Federation, the Japan Bicycle Promotion Institute, and the United Methodist Church. Consumer groups are also represented at climate change negotiations and especially in the US they have become powerful and influential players. These organizations have concerns that vary from anticipated price increases for energy and gasoline, to the ethical issues revolving around fairness and poverty across societies and generations, or even to specific creation scientific or evolution religious beliefs (Raustiala 2001).

As a group, NGOs have certain strengths and weaknesses that can impact negotiations in a variety of ways. NGOs can and often help set international agendas, provide policy advice/information, monitor state activities, help with implementation,

apply political pressure, and regularly raise public awareness of environmental problems (Raustiala 2001). These strengths vary from organization to organization and from issue to issue. Nonetheless, NGOs are perceived to have some weaknesses.

NGOs often represent special interests and they sometimes have problems balancing their perspectives, priorities, and advice against the perspectives, priorities, and advice of other NGOs and the public as a whole. Also, many NGOs are not very transparent in their operations, are usually not neutral on issues, sometimes do not have the resources or the intentions to produce quality advice/information, and usually do not have a peer review process to enhance production of superior products (Raustiala 2001). Just as diverse are the expert, epistemic communities and individuals, who also bring different and unique agendas to the climate change debate table.

Epistemic Communities and Individuals

Expert, climate change epistemic communities are informal networks of area experts “with shared causal beliefs, methodologies, and normative stances, as well as a common policy enterprise” (Haas 1992, 3). Often, the specialty of the epistemic community is to provide expert advice to governments and to reduce uncertainty surrounding a very complicated subject. The extremely complex scientific nature of global climate change and the high relative degrees of uncertainty in much of the underlying science naturally attracts the inputs, influence, and advice of scientific epistemic communities (Raustiala 2001). Sometimes as individuals or as groups working together, the scientific epistemic community can have great clout in climate change issues. For example, in 1997 over 2,000 economists (mostly US), including 6

Nobel Prize laureates signed an open letter to the President endorsing a system of carbon taxes and permit auctions as viable and economical policy options that would slow climate change without reducing American economic standards (Wiener 2001). The policies endorsed are even touted as being capable of eventually improving American productivity in the future (Raustiala 2001; Wiener 2001). Experts, often trading on their expertise and perceived political neutrality and legitimacy, are influencing and informing the climate change policy makers, and their numbers are proliferating as the debates intensify (Skolnikoff 1999; Raustiala 2001).

In 1988, National Aeronautics and Space Administration scientist, Dr. James Hansen, is credited with bringing global climate change issues to the intergovernmental level and to international attention, when he testified before the US Congress that he was almost certain that the record hot weather of that year was the result of human induced climate change (Rosencranz 2002). Also, in 2001, President Bush may have singularly altered the prospects for ratification of the Kyoto Protocol by declaring that the US would not sign the Protocol in its current form (Bush 2000). Critics of the President's actions assert:

The third assessment of the state and knowledge of climate change science from IPCC's Working Group I claimed that "there is new and stronger evidence that most of the warming observed over the past 50 years is attributable to human activities." That Bush chose to refrain from endorsing these conclusions, despite the huge and impressive contribution by US scientists, may be an indication of the political biases that frame his administration. US politics, like all politics, relies on coalitions of interests that mobilize around causes. Scientists normally shun politics and coalition building. Maybe the US scientific community has not done enough to galvanize political opinion around the implications of its findings and the rigor of its assessments (O'Riordan 2001, 1).

While supporters of the US's withdrawal contend:

The fundamental principle on which the Kyoto Protocol is based-setting "targets and timetables" for reducing greenhouse gas emissions-is both economically flawed and politically unrealistic. To ratify the protocol, a developed country must be willing to agree to reduce its emissions to a specified level-typically about 5 percent below the country's emissions in 1990-by 2008 to 2012 regardless of cost. Because costs could be huge, most developed countries will never ratify the treaty or will insist, as a precondition, that their targets be diluted through an accounting adjustment that allows credit for activities that absorb carbon (called sinks). Countries that do ratify are unlikely to comply if the constraints become seriously binding. Developing nations, which will become the world's largest emitters in coming decades, have even less incentive to sign on (McKibben and Wilcoxon 2002, 6).

The statements above illustrate the complex and often subtle influences of and interaction between not only individuals, but also epistemic communities, environmental, business, and trade NGOs, other non-state actors, as well as governmental organizations and governmental officials as they debate global climate change dilemmas. Obviously, individuals, non-state actors, and state actors have had and will continue to have enormous impact on how the climate change negotiations evolve. The strength of the liberal perspective comes from the recognition and consideration of this plurality of domestic and international interests.

Key Actors – Summary

Realists stress a state centric approach that focuses on state interests, power, security, and autonomy. The most important actors are states and domestic issues are not as relevant in international relations issues. Realists, for the most part, are not interested in the linkages between domestic and international politics (Dougherty and Pfaltzgraff 2001). Neorealists believe that the international system exerts a far-

reaching effect on states and not the other way around and this effect shapes the behavior of the states (Waltz 1979). The current “world capitalist system” is centered on the modern state and has been for over 500 years. This neat, homogenous, comprehensive approach assigns similar goals to all state actors (security, power, autonomy) within the anarchy of global society (Daugherty and Pfaltzgraff 2001). On the other hand, most liberals and all pluralists contend that this approach is narrow or single minded.

Liberals contend that the real decision and policy makers are individuals and groups, not abstract states (Viotti and Kauppi 1999). Many significant decisions that affect state and non-state actors are made outside the framework of states by IOs, NGOs, international regimes, and by individuals. The global climate change debate does have characteristics of both realist and liberal assumptions. However, because realists often only focus on the actions of states in a single-minded approach to international relations, much of the activities, interactions, bargaining, negotiations, and other coercive and cooperative behaviors that are highly influential on climate change politics, are often overlooked. Although the state is still the principal actor in international relations, it is far from being the only actor of significance. All in all, the liberal perspective accommodates this broad panorama of interested, influential, and effective actors involved in the climate change debate much more comprehensively and effectively than does the realist perspective.

Central Motivations – Introduction

The two worldviews have differing conceptions of what motivates international relations actors or what embodies the norms of behavior. Realist theory describes a pessimistic, state-centered world where international anarchy (Bull 1977) promotes conflict and rivalry and inhibits global cooperation (Grieco 1988). Realist norms therefore are self-help, survival, security, autonomy, and the constant struggle for power and balancing of capabilities (Carr 1939; Morgenthau 1978; Waltz 1959, 1979; Gilpin 1975, 1981). Also, realists assume history is not progressive, but repetitive or cyclical (Keohane 1989a; Zacher and Matthew 1995) and preferably stable (Waltz 1979; Hughes 1997).

Liberals describe and explain the world using more optimistic terms than realists. In the liberal world the major agents are individuals, groups, organizations, and institutions that are all gradually, irregularly progressing in ways that increase human freedom and economic well-being (Smith 1937; Locke 1960; Rousseau 1968). Optimistic assessments for the prospects for global cooperation are followed by equally optimistic projections for peace, prosperity, and justice (Ricardo 1911; Zacher and Matthew 1995; Kant 2001). Various liberal norms such as cooperation, reciprocity, negotiations, interdependence, democracy, international law, justice, welfare, education, freedom, and liberty dominate liberal notions of how the world should function (Smith 1937; Locke 1960; Rousseau 1968; Angell 1913; Keohane and Nye 1977; Moravcsik 1997). With a progressive view of world affairs and a focus on individuals, groups, and organizations, liberals deal with the climate change issues from a more distinct vantage point compared to realists.

Realist Central Motivations and Global Climate Change – Introduction

Four of the most relevant realist terms that global climate change will affect include international security situations, power issues, autonomy of states, and maintenance of the status quo (Hughes 1997; Rowlands 2001). For most realists, security concerns are the “effort to protect a population and territory against organized force while advancing state interest through competitive behavior” (Dabelko and Dabelko 1995, 3).

Security Interests

A representation of a threat that climate change poses to realist security concerns involves predictions of global sea level rise. Directly, many small island states worldwide, such as Tuvalu, Vanuatu, and Fiji, could be totally inundated by rising sea levels and therefore cease to exist (Houghton 1997; IPCC WG II, 2001; Schneider, Rosencranz, and Niles 2002). The Alliance of Small Island States (AOSIS) has argued that even a modest rise in sea level poses a grave threat to their national security (Stern 1999). Therefore, the very territory, populations, and ultimately the survival of these states are precisely affected by global climate change. In addition, other states may lose significant portions of their territory to rising seas that could directly affect their security. Egypt, Poland, Bangladesh, and Vietnam are among the developing states that have been identified by the IPCC as especially vulnerable to territory losses by increases in the volume of the oceans (Adams, Hurd, and Reilly 1999; IPCC WGII, 2001).

Climate change also has the potential to affect another aspect of population security, food security (Myers 1993b).

Several studies of the effects of temperature increases on food production and food prices indicates that an increase of a few degrees °C or greater in the global mean temperature “would prompt food prices to increase due to a slowing in the expansion of the global food supply relative to growth in global food demand” (IPCC WG II, 2001, 11). Scientists have also determined that if current climate change conditions continue, by the year 2100, global grain production could vary anywhere from -20% to +1% and grain production in developing states might range from -7% to -16% (Crosson 2001; IPCC WG II, 2001). The estimated changes vary based on how farmers would adapt to changes in climate and the differential effects on plants of enhanced carbon dioxide fertilization (Crosson 2001). Importantly, small food importing states in sub-Saharan Africa are especially vulnerable to climatic changes that would reduce their grain harvests (IPCC WG II, 2001). Even the US is susceptible to climate change effects since productivity in some areas of the US could benefit from predicted climate change (northern states) while other areas may see agricultural productivity fall (southeastern states) (Adams, Hurd, and Reilly 1999). Another core realist term that describes or explains climate change disputes involves power issues.

Power Interests

The President of the United States has asserted that he opposed the Kyoto Protocol because “it exempts 80 percent of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the

US economy” (Bush 2001a). The President was obviously concerned that ratification of the Kyoto Protocol would endanger the global power position of the United States. The power calculation surrounding who determines the international rules for dealing with global climate change, which the President was contesting in his statement, have led some scholars to apply specific realist concepts to the debate.

Noted climate change analysts argue the US is a “climate hegemon” with the ability to influence the climate change issue in both positive and negative ways (Rowlands 2001, 46). This comparison is compatible with realist assertions that if a single actor with a preponderance of power were willing to use its resources for specific purposes to control international activities, then that actor would have global hegemonic influence (Gilpin 1975). Because the US is responsible for over 24% of all carbon dioxide emissions worldwide (CDIAC 2003) and because the US accounts for over 25% of the world’s gross domestic product (WRI 1998), this view appears to have validity (Rowlands 2001). Finally, in reference to the President’s withdrawal of the US from the Kyoto Protocol, inaction by the US could also in effect block or veto any international negotiations that the US deems harmful to its power capabilities. A third example of a core realist tenet being expressed in the climate change debate concerns the autonomy of states.

Autonomy Interests

The autonomy of states involved in the climate change negotiations was recognized by the international system in the United Nations Framework Convention on Climate Change (UNFCCC), which states that the parties to the convention reaffirm “the

principle of sovereignty of States in international cooperation to address climate change” (UNFCCC 1992, 2). The sovereignty of states is a bedrock principle of international relations, essential for the autonomy of states, and a core concept of realist theory (Snow 2000, 2003). However, states must suspend some of their autonomy if a global accord on climate change is to be reached and consequently, the relative degree of sovereignty that must be relinquished has become a central issue in negotiations. Some scholars believe that “embedded in modern environmental diplomacy is a fundamental tension between the concept of national sovereignty over indigenous resources and environmental stewardship” (Rosenbaum 2002, 348). Many nations and a variety of international actors feel that it is an affront to have the UN (through the UNFCCC and the Kyoto Protocol) decide how much they must cut their emissions of greenhouse gases. Realists consequently would agree that, “all nations appraise prospective environmental policy first by its apparent impact on their own sovereignty and power” (Rosenbaum 2002, 350). Furthermore, climate change will have additional affects on autonomy besides impacting sovereignty and power issues.

Climate change will affect the autonomy of many states by potentially restricting many of the economic choices that states currently enjoy. For example, the economics of adaptation and mitigation come with a variety of policy options and widely divergent potential costs and benefits (Nordhaus 1994; Schelling 1997; Luterbacher and Sprinz 2001; Toman 2001; Schneider, Rosencranz, and Niles 2002). Estimates of the economic costs of mitigation and adaptation efforts vary from 1.0-1.5% of gross domestic product (GDP) per year for developed states to around 5% of GDP per year for developing states (Houghton 1997). However, estimates of the potential

costs of damages resulting from a doubling of greenhouse gas concentrations range from 1.0-1.5% of GDP per year for developed countries to 2.0-9.0% of GDP per year for developing states (Shogren and Toman 2001). Obviously, the economic problems from global climate change will impact the economic autonomy of all states. Another core assumption of realists is a static worldview that emphasizes stability, relative peace, and maintaining the status quo (Hughes 1997).

Status Quo Interests

One area of the realist model that may not adequately explain or describe climate change issues is the static, non-progressive, cyclical image of international relations that realist theory supports (Waltz 1979; Keohane 1989a; Zacher and Matthew 1995; Hughes 1997). Global climate change is a planetary scale environmental issue with immense social, political, and economic challenges. The challenges range from benign to beneficial effects on plant growth from a carbon dioxide enhanced atmosphere to potentially catastrophic impacts on plants, animals, food supplies, water supplies, coastlines, and human health (Schneider 1997). The history of how the Earth's climate has varied and why provides greater insight into the dynamic nature of the global warming challenge and realist concerns for maintaining the status quo.

Twenty thousand years ago marked the end of a cyclical major ice age that was interspersed with warmer periods and since, for approximately 10,000 years before present, the Earth has been in a warm interglacial period (Houghton 1997). The repeated glacial advances and retreats over the course of millions of years created temperature variations in excess of 18°F (10°C) (NRC 2001). The current global

temperature of the planet varies from -40°F (-40°C) in Antarctica to 144°F (80°C) in the Sahara Desert (Michaels and Balling 2000). This temperature variance has been primarily maintained for thousands of years by a variety of climatic factors to include solar output, volcanic activity, and concentrations of naturally occurring atmospheric gases. One of the major factors contributing to the relatively stable global temperatures is what has been called the *natural* greenhouse effect, which is determined by the concentration of certain atmospheric gases (Michaels and Balling 2000). As a result, the issue of global climate change for most of its early history had been primarily a scientific concern.

As scientific understanding of the greenhouse problem improved the locus of the debate shifted from the scientific arena to the political arena. In 1985 global climate change became an intergovernmental issue. Prior to this year, actors from the climate and environmental scientific fields had dominated climate change debate. The 1985 Villach meeting and the 1988 Toronto conference on climate change were watershed events in developing a climate change regime and these occurred outside of the political power domain of states (Bodansky 2001). This process of progressive change and regime evolution is difficult to assimilate under realist concepts (Grieco 1988; Baldwin 1993a; Kegley 1995) and the inability of the realist model and in particular the neorealist approach (Waltz 1979), to account for structural change is one of realism's major limitations (Dougherty and Pfaltzgraff 2001).

Obviously, core realist assumptions can be used to explain and describe many issues surrounding the global climate change debate. It appears that security, power, and autonomy concerns are inherent in many of the explanations and descriptions that

scientists, policy-makers, and even citizens use when debating climate change issues.

On the other hand, the non-progressive, static view of world affairs that realism embraces creates limitations for realist models to succinctly describe and explain the dynamics of global climate change. As a contrast, liberal explanations and descriptions of the world of international relations are strikingly different in many respects, from realist views.

Liberal Central Motivations and Global Climate Change

Most liberals would identify with the core values of increasing freedom and economic well-being (Zacher and Matthew 1995; Hughes 1997; Goldstein 2003). Freedom and economic well-being have often been equated to what some famous liberals describe as “life, liberty, and the pursuit of happiness” (Hughes 1997). These core values are very evident in explanations and descriptions of the impacts of global climate change. In the opinion of many of the researchers studying environmental change, global climate change is a direct threat to the “life, liberty, and happiness” of millions of individuals around the world because it negatively impacts six major facets of life: (1) global biodiversity and food production, (2) personal property via sea level rise, (3) freshwater supplies, (4) human health via infectious diseases, and (5) unequal mitigation and adaptation capabilities and climate change impacts.

Biodiversity, Food Production, Freedom, and Economic Well-Being

The IPCC concludes that natural systems like coral reefs, mangroves, boreal and tropical forests, polar and alpine ecosystems, prairie wetlands, and remnant native

grasslands are at substantial risk to the extinction of vulnerable species and subsequently, loss of biodiversity (IPCC WG II, 2001). These ecosystems provide a variety of sustenance resources to countless millions of people globally. The IPCC also states that it is “well-established that the geographical extent of damage or loss, and the number of ecosystems affected, will increase with the magnitude and rate of climate change” (IPCC WG II, 2001, 5) and other scientific studies concur (Malcolm and Pitelka 2000; Root and Schneider 2002; Parmesan and Yohe 2003; Root et al. 2003; Thomas et al. 2004). If climate change exceeds the mid-case parameters predicted by many climate models then catastrophe may result for many states around the planet.

Researchers studying biodiversity have concluded that ecosystem goods and services provided by plants and animals, such as marketable goods, recreation, maintenance of species, aesthetic and spiritual experiences, and ecosystem services (soil nutrient creation, absorption of CO₂, production of oxygen, erosion control, etc.) will be disrupted and the quality and quantity of goods and services diminished by global climate change (Malcolm and Pitelka 2000). One of the major factors affecting plant and animal biodiversity are anthropogenic barriers to dispersal (habitat fragmentation) (Schneider 1997; Parmesan and Yohe 2003). Another major factor is the inability of most plant species and some animal species to move quickly to more optimum climate zones over the relatively short geologic period of time that is predicted for substantial climate change (Schneider 1997; IPCC WG II, 2001). As a result, when climate zones shift, the reductions in species numbers and extinctions that ensue, will threaten regional and global biodiversity. Therefore, in a direct manner personal freedom and economic well-being would be negatively affected by the deleterious impact of climate

change on biodiversity. In a similar vein climate change impacts on global agriculture and food supplies would have uncertain results. Some impacts would be positive, yet most would be negative.

Plant ecosystems, like, agriculture and forestry are expected by some scientists to benefit greatly from increased carbon dioxide (CO₂) fertilization. Researchers have found that increased concentrations of CO₂ enhance the photosynthetic capacity and consequently the carbohydrate yields of most plants (Cure and Acock 1986; Allen et al. 1987; Jones 1997; Michaels and Balling 2000). The positive response to increased concentrations of CO₂ cuts across all botanical boundaries and is present, to greater and lesser degrees, in most types of vegetation. Additionally, some scientists predict that global warming will result in longer growing seasons, again enhancing agriculture and forestry production in many areas of the globe (Michaels and Balling 2000). However, other researchers have come to distinctly opposite conclusions.

The IPCC concludes, “even though increased CO₂ concentration can stimulate crop growth and yield, that benefit may not always overcome the adverse effects of excessive heat and drought” (IPCC WG II, 2001, 9). In particular, researchers have found important natural threshold levels exist where increases in temperature and CO₂ concentration to levels that vary from plant species to plant species, create positive effects on plant yield and growth. However, researchers also find after a plant specific equilibrium level is exceeded then plant growth and yield levels decrease (Rosenzweig et al. 1995; Smith et al. 1996; IPCC WG II, 2001). The threshold levels vary from plant species to plant species and also from region to region, usually by geographic latitude

(Smith et al. 1996; IPCC WG II, 2001). The negative effects of climate change on global biodiversity create a more indirect threat to individual well-being.

The threats to food security identified earlier and concerns for global biodiversity obviously apply to liberal perspectives often uneasy about the well-being of individuals, groups, organizations, and states. Climate change also affects other basic necessities of life around the world. A catastrophic threat to liberal freedoms and economic well-being comes in the form of climate change induced sea level rise.

Sea Level Rise, Freedom, and Economic Well-Being

Globally, by the year 2100, sea levels are predicted to increase from 3.5 inches to almost 35 inches (0.09m to 0.88m) (IPCC WG II, 2001). The net effect from an increase anywhere near the maximum prediction is flooding of many major estuaries, coastal marshes, and wetlands around the world that would destroy the nurseries of many commercial fish, crab, and shrimp species. Over two-thirds of the fish stocks consumed by humans (as well as many fish stocks consumed by birds and other animals) depend on estuaries, coastal marshes, and wetlands for habitat during some parts of their life cycle (Houghton 1997). Climate change programs modeling the US conclude that a 36 inch (1-meter) rise in sea level would inundate 13,000 mi² (35,000 km²) of land equally divided between wetlands and uplands and an 18 inch (0.5 meter) rise would inundate 9,000 mi² (24,000 km²) (Neumann, Yohe, and Nicholls 2000). Besides destroying productive wetlands and uplands, the personal property, homes, and businesses, and consequently, the “life, liberty, and pursuit of happiness” of individuals living in major cities like New Orleans, Tampa, Miami, Baltimore, Philadelphia, New

York, Boston, and Washington D.C. would be severely degraded by sea level increases of these magnitudes. Another threat to human well-being comes in the form of degradation to a basic necessity of life.

Freshwater, Freedom, and Economic Well-Being

The availability of clean freshwater, vital to everyone's well-being, is predicted to be substantially affected by global climate change (Houghton 1997; IPCC WG II, 2001; Schneider, Rosencranz, and Niles 2002). Changes in evaporation, precipitation, snowfall, run-off, and transpiration patterns could be significant and would vary enormously globally. Additionally, saltwater intrusion into freshwater aquifers along coastlines around the world would cause devastating degradation of valuable and scarce freshwater resources (IPCC WG II, 2001). Furthermore, several computer simulations indicate that droughts and floods would occur more frequently and be more severe as average temperatures increase during global warming (Houghton 1997; IPCC WG II, 2001; Schneider, Rosencranz, and Niles 2002). Accordingly, harmful climate change induced shocks to freshwater supplies could radically restrict freedom for self-fulfillment and destroy lives and economic well-being around the globe. Climate change may also negatively affect some of the numerous factors that control the spread of infectious diseases.

Infectious Diseases, Freedom, and Economic Well-Being

Many scientists agree that changes in climate as a result of global warming are one of a number of factors that regulate the incidence of infectious disease (some of the

other factors are local environmental conditions, socioeconomic circumstances, and health care infrastructure) (Balbus and Wilson 2000; IPCC WG II, 2001). All agree, however, that many vector-borne diseases thrive better in warmer, wetter, temperate conditions. Some of the diseases that are very likely to spread to areas that are predicted to become more temperate are malaria, schistosomiasis, filariasis, West Nile virus, Dengue and Yellow fever (Stone 1995; Pirages 1997; Pirages and DeGeest 2004). Studies have found that increases in temperature from 5-10° F (3-5°C, which is in the upper range of IPCC predictions) could increase the geographical range of malaria transmissions by forty-five to sixty percent. Globally, the health of 40% to 50% of the world's population is indirectly affected by malarial or Dengue fever infection (IPCC WG II, 2001). Specifically, over 350 million people are infected by malaria each year and over 2 million people die (Houghton 1997). This presents another example of a direct threat to liberal concerns for global freedom and well-being produced by global climate change.

Inequality, Freedom, and Economic Well-Being

Climate change will obviously not impact all people the same and not all people will be able to respond to climate change impacts the same. The IPCC recognizes that those with the least resources will also have the least capacity to adapt to climate change and thus are the most vulnerable (IPCC WG II, 2001). Many studies indicate a mixed bag of economic gains and losses for states around the globe, with losses overall outweighing the gains as global temperatures increase. In addition, most studies indicate that increases in global mean temperatures would produce net economic losses

in many developing countries, with greater losses occurring the higher the level of warming (IPCC WG II, 2001). Global climate change would complicate and multiply the already substantial inequality problems created by population growth, resource depletion, and poverty, all perplexing situations that drag on the attempts for progress in all developing states (Myers 1993, 1993a, 1993b). Cumulatively, sea level rise, reduction of fresh water resources, degradation of agriculture and food supplies, depreciation of natural ecosystem capital, and spread of infectious diseases would all negatively impact the countries that are least able to deal with these climate induced challenges. Estimate of the societal impacts of climate change concludes that the destabilization of some of the already fragile states around the world could create up to 3 million environmental refugees each year or over 150 million environmental refugees by 2050 (Houghton 1997).

All these issues, problems, and threats created by global climate change are a direct menace to the freedom and well-being of people around the planet. However, the liberal model offers a worldview that accommodates many of the most influential and consequential impacts of climate change.

Progressive Change, Freedom, and Economic Well-Being

Another dimension of the liberal model is the progressive view of the future of international relations shared by most liberals. Most liberals believe in a steady, yet uneven, expansion of human freedoms and improvement in economic welfare over time (Zacher and Matthew 1995; Hughes 1997). The progressive nature of liberalism blends well with the progressive predictions of the impacts of climate change forces.

Global climate change is believed by many researchers to be a cumulative and potentially non-linear process. In the past, neither climate nor atmospheric compositions have been static, as life on Earth has evolved from the age of bacteria, to the age of dinosaurs, through to the age of man. Climate scientists debate whether climate fluctuations in the system are deterministic, stochastic, chaotic, or all of the above at different times (Schneider 1997).

The current interglacial epoch has lasted 10,000 years and has been considered climatically very stable up to now. These interglacial periods are predicted to last approximately 10,000 to 20,000 years and are followed by very deep ice ages, glacial periods that last around 100,000 years (Schneider 1997). Natural rates of climate change are estimated to be about 1.8° F (1°C) per millennium during this epoch but fluctuations have occurred. A “little ice age” caused widespread famines in Europe between about 1500 till the middle of the nineteenth century as a result of climate induced crop failures (Deudney 1999). Nevertheless, during this current epoch CO₂ and methane concentrations had been relatively stable, that is until recently.

The recent change in relative stability of the climate is of course what the climate change debate is all about. All in all the models that predict climate must account for a variety of transitional variables. The liberal worldview accounts for more transitional variables than do realist worldviews. Consequently, models that can account for change are more likely to explain and describe the world more completely and accurately than models that do not fully accommodate change or models that do not consider the possibility of progressive change.

Central Motivations - Summary

The realist model can explain and describe some aspects of the climate change debate using its central motivations of security, power, and autonomy. However, the liberal model can more completely and accurately describe and explain the pertinent and controversial issues that dominate debate over the causes and potential responses to global climate change. The liberal central motivations of freedom and economic well-being capture many of the essential arguments and issues inherent in the climate change deliberations. Another major difference between the two worldviews emanates from the liberal view that security and power concerns are not the only relevant issues debated in climate change arguments (Holsti 1995). Other, very important international processes involving states, institutions, and international organizations are developing during climate change discussions. Also, issues such as trade, immigration, migration, health, and the environment are recurring topics of top-level discussions by climate change policy-makers. In response, liberal models adapt to the emerging climate change arguments that are most relevant to international relation issues in a more useful, pragmatic, and relevant manner than do realist models.

Realists have been accused of being “wedded to the past and thus incapable of dealing with change adequately” (Holsti 1995, 45). In contrast, liberals recognize that international politics are evolving, security and power interests change, and that the forces affecting opportunities for cooperation are becoming more powerful and varied (Zacher and Matthews 1995). The inability of the realist paradigm to account for new global challenges and cleavages, such as European integration, the end of the Cold War or global environmental change, and the inability of the realist paradigm to incorporate

different policy preferences other than security and power significantly weaken its theoretical applicability (Kegley 1995). The liberal view of a progressive, uneven march of human social, political, economic, and environmental activities is more adaptable to investigating a dynamic, perhaps stochastic or chaotic issue of the disposition of global climate change and even is more adaptable to investigating the evolution of international relations in general.

Central Problems – Introduction

A third divergent area between the worldviews concerns the central problems of international relations that realism and liberalism attempt to engage. All theorists of international relations accept that the causes of conflict and cooperation are core issues (Dougherty and Pfaltzgraff 2001). However, realism focuses above all on the “causes of war and the conditions for peace,” while liberalism investigates a “broad agenda of social, economic, and environmental issues arising from gaps between demands and resources” (Holsti 1995, 42). Nevertheless, even though liberals concur with the well-placed attention that realists imbue on issues of war and peace, concerns for additional issues such as welfare, freedom, modernization, and the environment, are also potent motivators of global interests and deserving of research from the liberal perspective (Holsti 1995). The first central problem discussed will be the realist focus on war and peace and how it creates unique challenges when dealing with global climate change issues.

Realist Central Problems and Global Climate Change – Introduction

Realists have long contended that international politics is a struggle for power, or as Thomas Hobbes put it, “a war of all against all” (Morgenthau 1978). Classical realists read history and conclude that humans are essentially “sinful and wicked,” states must do whatever is necessary to survive in an anarchic world, and conflicts of interest or even wars are inevitable (Kegley 1995). Additionally, neo-realists investigate the inherently conflictual structure of the international system for the causes of war and peace (Waltz 1979). Conflict is thus viewed as a natural state of affairs that is not attributable to liberal claims of bad leaders, imperfect sociopolitical processes, inadequate international education, or even to historical conditions (Holsti 1995). Also, realists view economic power as less central to national security than military power. Economic power is primarily important as a means to increase national military power, security, and prestige (Morgenthau 1978; Waltz 1979; Kegley 1995). Interestingly, whether global climate change and global environmental issues in general are inherently security issues or not has been the subject of much acrid debate recently (see Deudney and Matthew (1999) and Diehl and Gleditsch (2001) for more information on the environmental security debate) (Foster 2001).

Security, War, and Peace

Candidates for global security threats include “global economic competitions, the tensions between rich and poor nations, population growth and migration, and global environmental change as well as the more traditional conflict-related threats of nuclear proliferations, ethnic and religious wars, terrorism, and drug wars” (Kates

1994). Security implications found in environmental change have been further linked to other significant global issues like air and water pollution, water scarcity, deforestation, loss of arable land, decreases in biodiversity, unsustainable consumption of fish stocks, and global climate change (Tuchman-Mathews 1989; Homer-Dixon 1999). In the opinion of some scholars, climate change does generate some security related concerns.

Changes in climatic conditions could reduce global food supplies, as discussed earlier, and this could increase insecurity and conflict in many parts of the world as competition for food sources would escalate (IPCC WG II, 2001). In addition, populations that may be adversely affected by climate changes may choose to migrate to more hospitable regions ((Myers 1993; IPCC WG II, 2001). The potential confrontations that may result could be of the nature described as “group identity conflicts” (Homer-Dixon 1999, 8-9). As alluded to earlier, negative living conditions induced by extreme climate changes may generate over three million environmental refugees which would create very daunting security challenges for many states around the world (Myers 1993; Houghton 1997). However, the major bone of contention is whether the environment is a security issue that could lead to violent conflict.

Some scholars contend that inserting environmental security issues into national security discussions is a mistake. The differing arguments are asserted to have very little in common in relation to causes or solutions and the emerging environmentalist worldview (Catton and Dunlap 1978; Dunlap and Catton 1994) directly opposes the core realist national security worldview (Deudney 1999a). One scholar succinctly states, “for environmentalists to dress their programs in the blood-soaked garments of the war system betrays their core values and creates confusion about the real tasks at

hand” (Deudney 1999a, 214). It also seems very unlikely that states will go to war against other states that decided not to join a global warming regime (Rowlands 2001).

Overall, the climate change debate involves broader social, political, and economic issues that transcend even realist oriented security issues. Additionally, the one-dimensional focus by realists on war and peace issues prevents them from recognizing the increasing complexity, intensity, and vigor of international relations in general (Vasquez 1993; Holsti 1995). Yet, do the central problems that liberals engage address the driving forces of global climate change better than realist arguments?

Liberal Central Problems and Global Climate Change – Introduction

Liberals have a much more multifaceted agenda than do realists and this agenda reflects the changes to modern society during the twentieth century and in particular to international relations after the end of the Cold War. Similarly, global climate change is a multifaceted social, political, economic, and environmental challenge that interacts with issues like air pollution, land use, transportation, industrial development, energy resources, governmental policies, and individual freedoms and responsibilities (Schneider, Rosencranz, and Niles 2002). Each of the previous issues when viewed separately can illuminate the complexity of the climate change debate and how the liberal perspective’s expansive approach can deal with this dilemma effectively.

Air Pollution and Land Use

Global warming can have both positive and negative effects on air pollution. Higher air temperatures can increase air circulation, which could shift air pollutants

away from populated areas. On the other hand, scientists have found that higher temperatures tend to increase ozone levels in urban areas and warmer weather may enhance dispersion of fungal spores and pollen, increasing allergic reactions and asthma (Balbus and Wilson 2000; Turman 2001). As a threat to individual as well as community health, liberals would be able to discuss the peculiarities of this climate change dilemma.

Land use is also intimately intertwined with climate change issues. In the US 70% of the emissions of nitrous oxide (a potent greenhouse gas with a global warming potential approximately 300 times greater than carbon dioxide) come from application of nitrogen fertilizers. Also in the US, 37% of all methane emissions (another potent greenhouse gas with a global warming potential approximately 20 times greater than carbon dioxide) in 1990 came from landfills (Bernow et al. 2002; Reilly, Jacob, and Prinn 2003). Furthermore, the carbon content of soils is regulated by a variety of agricultural land-use practices.

The extent of conservation tillage, crop rotation, use of winter cover crops, movement of animals, and other practices like soil fertilization and irrigation greatly impact the movement of carbon from the soil to the atmosphere and back (Pearson 2002). Liberals understand the implications inherent in land-use choices are embedded in individual freedom and economic well-being decisions. Liberals would also appreciate inferences to common good dilemmas and the effects of climate change on the atmospheric global commons.

Transportation, Energy, and Industry

The global transportation, energy, and industrial sectors are all directly affected by climate change discussions, solutions, and policies, and vice versa. Worldwide, in 1998, the transportation sector produced 24% of all CO₂ emissions, electric energy production produced 42%, and industry produced 20% of all global CO₂ emissions (IEA 2000). In the US these numbers are even more concentrated. In 2001, the US transportation sector produced 26% of all CO₂ emissions, electricity production accounted for 32%, and US industrial processes discharged 23% of all CO₂ emissions (USEPA 2001).

Fossil fuels are the dominant energy source in all three sectors (transportation, electricity production, and industry). Alone, fossil fuels used in these sectors account for some 81% of all CO₂ emissions in the United States. Any changes to consumption patterns would have dramatic effects on the US's and the world's economy (Schelling 1997; Nordhaus 2001; Luterbacher and Sprinz 2001; Toman 2001; Schneider, Rosencranz, and Niles 2002). Obviously, the economic well-being of billions of the world's citizens is tied to how climate change is mitigated or adapted to and this is a focus of liberal perspective discussions.

Governmental Policies

Another area that climate change has impacted are government policies where the focus is now on “no-regrets” guidelines that create positive net benefits regardless of the positive or negative effects of climate change. US Secretary of State James Baker first introduced the policy of “no regrets” in relation to climate change issues

during a speech on the greenhouse effect and other environmental problems in 1991. Secretary Baker stated, “We are prepared to take actions that are fully justified in their own right and which have the added advantage of coping with greenhouse gases. They’re the policies we will never have cause to regret” (Baker 1990). The recommended policies revolve around large-scale voluntary reductions of greenhouse emissions by industry and government sources, extensive energy conservation efforts, more fuel-efficient vehicles, and greater use of mass transit (NRC 1991). The Clinton Administration and the current Bush Administration also adopted the no-regrets policy.

New governmental research has examined the indirect benefits of climate change policies that, as a side benefit, reduced air and water pollution, and as a co-benefit increased fuel efficiencies in the transportation, agriculture, land use, and energy security sectors (Schneider and Kuntz-Duriseti 2002). In conjunction with general government plans are policies that specifically address sustainable development issues while simultaneously applying climate change mitigation and adaptation solutions. For example, saving rainforests from clear cutting has the double benefit of protecting biodiversity and preserving ecosystem services that prevent climate change (forests produce oxygen) and/or lessen climate change impacts (forests serve as low cost carbon sinks) (Schneider and Kuntz-Duriseti 2002). These proposals are aimed at improving cooperation potentials by creating win-win strategies and are central to core liberal visions of conflict negotiation, information sharing, lessening of transaction costs, and reduction of uncertainty (Keohane and Nye 1972, 1977; Zacher and Matthew 1995).

Freedom, Responsibility, and Welfare

The final example of how the liberal perspective is incorporated into the broad agenda of issues that affect climate change involves the core liberal values of individual freedom and responsibility which was discussed earlier in this chapter (Smith 1937; Zacher and Matthew 1995; Hughes 1997). Global climate change has the potential to affect millions of people around the world and the liberal perspective is the only worldview with a broad enough agenda to address the problems and issues that climate change is generating. Liberals focus on the welfare of self-interested individuals and assert that war is not inevitable, people are essentially good, and are capable of extensive international cooperation (Kegley 1995). The narrow interest that realists have in power, security, and war discounts the increasing influences of global climate changes on international societies, economies, and political processes. Global climate change has proven to be a multi-dimensional dilemma that demands a multifaceted approach. An approach that only a liberal viewpoint can deliver.

Central Problems – Summary

Realists and liberals disagree on the major problems that confront states today. Realists concentrate on the products of international conflict and cooperation, war and peace, while downplaying the role of domestic issues and problems (Dougherty and Pfaltzgraff 2001). Some realists argue the causes of war are found in the selfish, aggressive, and bellicose nature of humans (Carr 1939; Morgenthau 1978) while other realists contend war is a recurring feature of the anarchic structure of the international system that relies on a balance of power to create fleeting peaceful interludes between

constantly competing states (Waltz 1959). Domestic issues, environmental problems, and social forces are considered secondary to international power calculations based on the distribution of states capabilities (Gilpin 1981; Pease 2000). Climate change may result in intense economic competition between states but current cooperative efforts lessen the likelihood of serious violent conflict between states over climate change issues (Rowlands 2001). As a consequence, the narrow realist methodology sometimes leaves out related problems and issues that radically pressure international cooperation and conflict.

On the other hand liberals attribute conflict to competition for scarce resources and attempt to accommodate both multiple international and domestic agendas. The actors involved in competition are numerous, diverse, and often have congruent and competing interests (Pease 2000). Liberals also contemplate an expansive panoply of issues and problems that include both international and domestic concerns as well as environmental, social, political, and economics matters (Holsti 1995). The liberal agenda includes international discussions dealing with air pollution, land use, energy concerns, governmental climate policies, the freedom and well-being of global citizens, and many others. Liberal theory attempts to incorporate most of the problems that climate change may induce and does not narrowly focus on conditions for war and peace as realist theory does. Consequently, the liberal worldview should be more appropriate to answer the climate change challenge than the realist worldview.

Conceptions of Current International System – Introduction

The separate methodologies that realism and liberalism employ when analyzing the international system also present opportunities to dissect the global climate change debate and determine worldview applicability. Concepts of the international system vary from worldview to worldview. Some theories emphasize impermeable states operating within an anarchical international system, other worldviews emphasize the interdependence of individuals, groups, institutions, societies, or states as they strive to cooperate, others concentrate on the effects of capitalism and class conflict, while others focus on interactions between ethnic, nationalistic, or religious communities (Marx and Engels 1848; Waltz 1979; Keohane and Nye 1977; Hughes 1997). However, one conception of the international system common to most theories of international relations is the fundamental assumption of anarchy.

“Although no one denies that the international system is anarchical in some sense, there is disagreement as to what this means and why it matters” (Baldwin 1993, 4). Realists and especially neorealists contend that anarchy is the single most important characteristic underpinning international relations (Waltz 1979) yet it is also considered one of the most ambiguous (Milner 1991). One interpretation implies chaos, disorder, and for some, a state of war, as entailed by Hobbes’ view of international relations as a “war of all against all” (Bull 1977, 24-25). However, this is not what most scholars imply when they discuss international anarchy.

What is typically meant is that international anarchy is “a ‘self-help’ system in which many states must look out for their own security and other vital interests” (Daugherty and Pfaltzgraff 2001, 35) or more simply international anarchy is the

absence of a higher authority or world government that can enforce rules (Bull 1977; Pease 2000; Goldstein 2003). Although anarchy is an important characteristic of the international system it does not affect the internal, domestic system within states.

Realists and liberals point out that internally, states have highly centralized systems of norms, values, laws, and power that allow them to enforce contracts, discourage law-breaking, and compel law abidance. States ultimately also have a monopoly on legally sanctioned violence that they use to enforce laws (Goldstein 2003). It is the central governments of states that prevent domestic anarchy.

In the international system, there is no central authority that is legally sanctioned to enforce contracts, ensure compliance with laws, or to compel good behavior, thus there is international anarchy. What is of particular concern to realists is that in anarchy there is no central authority that can prevent other states from using violence, or threatening to use violence on other states, in order to advance their own interests (Waltz 1979; Grieco 1988). "In international politics, no one has a monopoly on the use of force" (Nye 2003, 4). Yet, in a positive vein, anarchy does not imply that states always act as they wish. The international system does have certain norms of behavior, such as sovereignty or diplomacy that most states adhere too closely. Nevertheless, anarchy does create certain powerful conflictual and competitive conditions that heavily impact the international system.

In the anarchic, self-help, international system, states must take action to assure their own security. These actions states take are often assumed by other states as threats to their security and consequently, security dilemmas ensue (Jervis 1978). Low trust between states, uncertainty of information, and concerns for survival all combine to

increase suspicion and mistrust. Consequently, most realists believe that the security dilemma is unsolvable (Goldstein 2003). In the realist perspective, concerns for security, survival, autonomy, and power are by-products of the anarchical international system but are also prerequisites for competition and conflict that conversely diminish potential for international cooperation (Grieco 1988).

Realist Conceptions and Global Climate Change – Introduction

Realists contend that international cooperation is possible but is “harder to achieve, more difficult to maintain, and more dependent on power” than do liberals (Grieco 1988, 729). The security dilemma also portends of other latent areas of conflict and competition between states concerning relative and absolute gains. Neorealists in particular suppose that states when faced with the possibility of mutual gains from cooperating feel insecure about how the gains will be divided and about how the gains will be used. States are primarily concerned that the gains from cooperation will be used by one side to increase their capabilities against the other side (Waltz 1979). The relative difference in capabilities between states often creates a situation that eventually makes cooperation that much more difficult (Grieco 1988).

The realist assertion that the international system is anarchical and that international cooperation is a difficult task most of the time has multiple implications for combating the consequences of climate change. Climate change, as stated before is a global problem that requires a global solution. Greenhouse gases are emitted in every state, in every city, town, and village, all around the planet. The oceans and winds transport these gases to every corner of the world creating a global, transboundary

social, political, economic, and environmental challenge. Unilateral efforts by individual states to decrease greenhouse gases are viewed by many scientists and policy-makers as ineffective and inefficient propositions (Toman 2001; Goulder and Nadreau 2002). One estimate concludes that a comprehensive, global climate change regime would cost 60% less than a piecemeal, unilateral approach (Wiener 2002). Consequently, approaches to mitigating or adapting to climate change require an enormous global shift away from fossil fuels as the primary energy source of the world's modern economy and the end to global deforestation—a very daunting task (Toman 2001). Additionally, the current focus on securing the world from transnational terrorism, a completely different “global public good” from negating global climate change, makes the prospects for creating a global environmental agreement even dimmer (Nordhaus 2001, 1284). In general, three zones of conflict hinder international cooperation within the international climate change regime and each domain has different dominant, realist traits that affect cooperation.

Realist Zones of Conflict

The first zone of conflict is between the states that have ratified (accepted, acceded, or approved are also methods to signify agreement to the Protocol) the Kyoto Protocol. These states are in disagreement on how to continue to make functional, efficient, and effective improvements to the Protocol. The second domain of conflict is between those that have ratified the Protocol and those that have not. This conflict centers on whether the Protocol is currently flawed beyond repair or is still basically a budding work in progress. The third conflict sphere centers on North-South issues,

where developed and developing states have significantly different climate change concerns involving the potential impacts of and solutions to global warming.

Ratifiers vs. ratifiers

The states that have ratified the Kyoto Protocol continue to have disagreements and difficulty cooperating. A few very outstanding issues dominate these disagreements. For example, the Kyoto Protocol does have legally binding quantitative targets and timetables for reducing greenhouse gas emissions for major greenhouse gas producers but lacks well defined compliance and enforcement mechanisms (Dannenmaier and Cohen 2000). Proponents of the Protocol contend that many first generation environmental accords, like the Kyoto Protocol, initially adopt a “soft” approach to international law and rarely have strict legal enforcement and compliance mechanisms. As a result, the Protocol currently relies upon self-reporting instead of international monitoring, inspection, or verification (Bodansky 2001a). Nevertheless, the Protocol is structured like the highly successful Montreal Protocol on ozone depletion, which eventually incorporated binding, specific obligations as time passed.

Nevertheless, if the agreement is to be seen as credible and effective, legal responsibility must be assigned for failure to abide by Protocol emission targets and detailed enforcement and compliance standards must soon be established (Dannenmaier and Cohen 2000; Kerr 2001). Enhanced credibility and compliance through a strict verification regime would also be needed to discourage free riding (Wettestad 1991; Dannenmaier and Cohen 2000; Bodansky 2001a). Realists naturally would emphasize the extreme potential for international cheating or free riding that would occur without

credible compliance and enforcement procedures (Stein 1982; Grieco 1988; Baldwin 1993). Also, realists would stress the propensity for some states to make relative gains at the expense of other states due to lax supervision and compliance procedures.

Another related concern and hindrance to cooperation among signatories of the Protocol involves the variety of mechanisms offered by the agreement for achieving greenhouse gas emission reduction limits.

The Kyoto Protocol has been accused of having a “devil in the details” problem due to its inherent complexity and critics have especially indicted the intricate flexibility options for emission reductions (Soroos 2001). The Protocol has five primary options for reducing emissions aimed mainly at the industrialized countries identified in the Protocol as Annex B countries (Annex I of the United Nations Framework Convention on Climate Change includes all Annex B countries in Table 3 plus Belarus and Turkey).

Table 3. Annex B States of the Kyoto Protocol

Australia	Finland	Liechtenstein	Russian Federation
Austria	France	Lithuania	Slovakia
Belgium	Germany	Luxembourg	Slovenia
Bulgaria	Greece	Monaco	Spain
Canada	Hungary	Netherlands	Sweden
Croatia	Iceland	New Zealand	Switzerland
Czech Republic	Ireland	Norway	Ukraine
Denmark	Italy	Poland	United Kingdom of Great
Estonia	Japan	Portugal	Britain and Ireland
European Community	Latvia	Romania	United States of America

The options include (1) sequestering additional carbon, for example in forests or underground (Article 2), (2) the Clean Development Mechanism (CDM) allows Annex I parties to earn “certified emission reductions” (CERs) for emission reduction efforts in

non-Annex I parties (Article 12) (3) an international emission trading structure where Annex B parties may engage in emission trading “supplemental” to domestic action, in other words, states that are below their allowed emissions limit could sell credits to nations that are above their allowed emissions limit (Article 17), (4) Joint Implementation projects allow Annex I countries or firms to earn “emission reduction units” (ERUs) for investments in mitigation projects with other Annex I parties (Article 6), and (5) any group of Annex I states may agree to pool their assigned limit amounts and fulfill their commitments jointly in what is now called “bubbles” (Article 4) (this option has mainly been used by the European Union (EU)) (Ringius 1999; Soroos 2001; Bodansky 2001a).

Although these mechanisms are touted as market-based and intended to provide maximum flexibility, some authors contend that the mechanisms provided by the Protocol are more likely to create very large reduction loopholes that would abrogate any global emission reduction targets (Soroos 2001; Toman 2001a). Critics also argue that the flexibility mechanisms will intrude on state autonomy and can be usurped by developed states at the expense of developing states (Agarwal 2002).

The perceived flaws in the Kyoto Protocol present unique challenges to international cooperation. State interests, uneasiness over potential relative gains, sovereignty concerns, enforcement and compliance debates, and even domestic issues make cooperation among the signatories of the Protocol very tenuous.

Ratifiers vs. non-ratifiers

The US has refused to ratify the Kyoto Protocol because as President Bush has often stated the Protocol is “fatally flawed in fundamental ways” (Bush 2001b). President Bush has specifically stated that the Protocol would force the US to “make deep and immediate cuts in our economy to meet an arbitrary target. It would cost our economy up to \$400 billion and we would have lost 4.9 million jobs,” and he also noted that “developing countries such as China and India already account for a majority of the world’s greenhouse gas emissions” (Bush 2001a) but have not accepted binding emission reduction targets. The President is obviously expressing grave realist concerns for relative gains by US competitors if the Protocol does not include developing states. However, liberal critics of the US perspective characterize US energy policy as being based on a history of cheap and readily available energy resources where key energy industries have undue influence on US foreign policy and in this case US climate change policy.

The so-called “gas guzzler” culture in the US has long been accustomed to low-priced energy (Paterson and Grubb 1992; Rowlands 2001). As a result, US interests are focused on trade balances and economic competitiveness with the EU and on competition issues with other industrialized states that have also signed the Protocol. The EU, in particular, is viewed by realists as having a major advantage over the US because European industries can cost-effectively reduce emissions more easily than US industries and the EU is perceived to have the lead in new energy-efficient technologies (Moore 1998; Grundig, Ward, and Zorick 2001). Another major US competitor, Japan increasingly promotes renewable and energy conservation technology internationally

and to domestic Japanese industries that are already among the world's most energy efficient. In contrast, current US energy policy focuses heavily on finding and exploiting new sources of fossil fuels and many US industries have shown particular disdain for energy conservation measures (Moore 1998; Schreurs 2003). Cooperation on climate change issues in this domain mainly reflects two different approaches or energy use cultures that are in many ways contradictory. Emanating from this contradiction are again the concerns that realists have about relative gains and specific anxieties that the Protocol will negatively affect a state's economic competitiveness and consequently enhance a competitor's relative capabilities. In an overlapping contour of conflict, a major line of disagreement continues to lie along the North-South divide.

North vs. South

The inclusion of the major states of the global South in climate change negotiations has been deemed essential for an effective and equitable climate change regime (Blackman 2001; Grundig, Ward, and Zorick 2001; Soroos 2001; Schneider, Rosencranz, and Niles 2002). Nonetheless, China, India, and Brazil, countries with large, growing populations on the path to modern industrialization, have attacked the Protocol as an infringement on their sovereignty and in particular as an attempt by the North to block their future economic development. These countries along with many other developing states have argued that the industrialized countries of the North are responsible for global warming, the North should take the first steps to combat climate changes, and the climate change issue is not just an environmental problem but also an equitable development dilemma.

Many developing countries are concerned that the North will simply buy its way out of domestic emission reductions and eventually place the burden for future reductions on the shoulders of developing states (Paterson and Grubb 1992; Anderson 1999; Soroos 2001; Ward et al. 2001). As a consequence, the South has concluded that any global climate change agreement that does not address both development aid and climate change environmental mitigation assistance for the South will be deemed incomplete and flawed (Paterson and Grubb 1992; Bodansky 2001a; Soroos 2001; Agarwal 2002).

The issue in the opinion of some Southern scholars has become “a tug of war, with rich countries unwilling to compromise their lifestyles, and poor countries unwilling to accept a premature cap on their right to develop” (Agarwal 2002). Realists observe that the overriding problem is that there is no dominant governance body that can determine what is fair and just during climate change negotiations. Anarchy has again slowed cooperation and weakened progress toward a strong, equitable, and legitimate climate change regime. In summary, realists would submit that international anarchy has allowed the competition between states that have ratified the Protocol, the conflict between states that have not ratified and states that have ratified, and the North-South divide to revert to contests over relative gains (costs), and consequently the promise of international cooperation has suffered (Grundig, Ward, and Zorick 2001).

Relative gains

The relative versus absolute gains debate revolves around the insecurity generated by mutual gains between states with the primary security question centered

on how the gains will be used. Realists contend that states are primarily concerned that relative gains will be used by one state to increase its power capabilities for use against another state (Waltz 1979). Furthermore, any change in relative capabilities between states often creates a security dilemma thus making cooperation even more difficult (Jervis 1978; Grieco 1988). For example, many US industries and government officials have identified China as a direct threat to American businesses and jobs and see any attempt to force greenhouse gas emission reductions on the US and not on China as grossly unfair, unnecessary, and economically damaging (Ward et al. 2001).

On the other hand, developing states like China, India, and Brazil do not see sufficient gains from the Kyoto Protocol and are wary that the Protocol is just another neo-colonial tool of the developed states. In past negotiations, the US and EU have been accused by developing states of collaborating on their differences, finding a compromise that worked for both, and then presenting a *fait accompli* (an accomplished, presumed irreversible deed or fact) to developing states (Agarwal 2002). Importantly, most developing states have stated that they will not participate in climate change negotiations until developed countries have taken tangible steps to reduce emissions, burden-sharing issues are resolved, and programs are clearly established that ensure technology transfers to and financial assistance for developing countries (Paterson and Grubb 1992). Relative gains for the South must come up-front, with an ample dose of equity, and perhaps a touch of redistribution thrown in for old time's sake. However, in a reversal of position perhaps unseen by Southern international relations scholars, the EU was unwilling to allow the US to buy its way out of the Protocol.

While the US was still negotiating, the EU insisted that the majority of US emission reductions had to be made domestically, not from international emissions trading, that forest sinks could not be used as a substantial mitigation measure, and that developing countries would not have to participate initially (Anderson 1999; Agarwal 2002; Niles 2002). All these concerns were more in-line with China and other developing states and were purportedly directed to balance against US demands and were an attempt to counteract the power of the alleged climate hegemon, the United States (Rowlands 2001).

Perhaps in response, the US withdrew from negotiations because the US would not be allowed to reduce emissions using the least cost methods and because the US would not be permitted to share the future costs of limiting emissions with developed and developing states. Apparently the concerns by most states for relative gains continue to spoil international cooperative opportunities and slow global climate change negotiations. Therefore, realists would clearly assert that institutions or regimes still do not alleviate anarchy's inhibiting influence on international cooperation (Grieco 1988). Nonetheless, liberals see the effects of anarchy on the international system somewhat differently than do realists.

Liberal Conceptions and Global Climate Change – Introduction

Liberals do not deny that the international system is anarchic but they do disagree with realists as to the fundamental character and results of anarchy (Baldwin 1993). In general, liberals believe that cooperation is the bedrock of a global society, that international anarchy can be moderated, and that all states gain from cooperating

(Kant 2001; Angell 1913; Doyle 1986; Keohane and Nye 1977; Moravcsik 1997; Russett and Oneal 2001). Liberals emphasize that global society interacts with and often sets the context for states and that anarchy does not sufficiently describe the international system (Nye 2003). Global society does have order based on norms, regimes, institutions, trade, and laws that create opportunities for negotiation, reciprocity, and cooperation (Goldstein 2003). The increasing webs of economic and social interdependence between and inside states have made states more aware, responsive, and susceptible to economic, technological, and environmental transformations nationally and internationally. Liberals, therefore focus on the prospects for cooperation among states, under anarchy, influenced by numerous additional factors to include shared democratic norms, economic interdependence, international organizations (Russett and Oneal 2001), and concerns for absolute gains (Lipson 1984; Powell 1991; Snidal 1991).

Kant's Three Pillars

Immanuel Kant was the most famous scholar to propose three pillars supporting liberal progress toward peace and prosperity: Kant's "republican constitutions" equate to today's representative democracies, "cosmopolitan law" is nowadays represented by global commerce and free trade, and Kant's "pacific union" corresponds to modern international law and organization (Russett and Oneal 2001). Scholars have investigated the pillars for relevance and accuracy and have slightly modified Kant's concepts for modern application. Consequently, a "virtuous" triangular relationship has been identified where democracy, economic interdependence, and international

organizations interact to enable, enhance, and increase peaceful relations and non-violent conflict resolution globally (Russett Oneal 2001). These three liberal pillars separately and in conjunction have enormous implications on the global climate change debate.

Democracy

Political science researchers have observed that cooperation is often reinforced or abated by the nature of a state's regime (Onuf and Johnson 1995; Doyle 1995; Russett and Oneal 2001). Democracies, in particular, encourage open movement of information, support peaceful opposition groups, and demand accountability by leaders (Russett and Oneal 2001). It is no coincidence that the leading states researching climate change issues are the world's foremost democracies. The US, the EU, and to a lesser degree, India are home to most of the world's most respected and influential climate change researchers, scientists, and policy-makers. It is acknowledged that these states alone have the necessary degree of investments, scientific expertise, and facilities needed to analyze such a complex problem as global climate change (Agarwal 2002). The result of cooperation and collaboration among these democracies are the highly influential IPCC reports published in 1990, 1995, and 2001 that are internationally recognized as providing the scientific consensus on global climate change (Wolfson and Schneider 2002). Democratic concepts of accountability, peer review, and critical assessment are built into the IPCC process. The overall result has been a transparent sharing of climate change information, data, and policy suggestions and assessments that are considered legitimate, fair, and accurate by most states. Another positive

characteristic of democratic regimes involves the norms, constraints and assumptions that democratically elected leaders operate under.

A central democratic norm that has evolved is that democracies rarely fight one another and in general are more pacific than other regimes (Russett and Oneal 2001). Also, democracies are often reluctant to use force to achieve national interests because of the high political costs from failure and are even constrained by the high potential costs of success (Bueno de Mesquita and Lalman 1992). In respect to the climate change regime that is developing, it is possible that one state could threaten a “climate agreement violator” with force (Rowlands 2001), but the pacific influence of democratic norms and values and concomitant political cost constraints makes this situation very unlikely between democracies but somewhat more likely between a democracy and an autocracy (Russett and Oneal 2001). Expanded, this assertion predicts that a global climate change agreement will be more likely between the democracies of the world while the autocracies of the world are less likely to agree to a constraining global climate agreement. The basis for this assertion is the joint effects of democracy and international organizations. Once a democratic regime enters into an international agreement it can be counted on to abide by the agreement’s standards and principles (Solingen 1996; Russett and Oneal 2001), the same cannot be said of the world’s autocracies.

Finally, this proposal is supported by the contention that democracies enhance norms of cooperation and peaceful conflict resolution because they have domestic legitimacy and are accountable to their populace (Solingen 1996; Russett and Oneal 2001), all necessary positive prerequisites for a global climate change agreement. A

slightly different feature of democracies is that democracies have a unique clientele that must be accommodated using sometimes, unparalleled methods.

Since democratic leaders have a large electorate to satisfy they are more apt to provide collective goods to large segments of the population than to satisfy the needs of a small group of patrons (Olsen 1993; Russett and Oneal 2001). Climate change mitigation and adaptation efforts are considered global public goods. However, some scholars contend the climate is not a pure public good because “use” by some regions, groups, or states has caused harm or diminished the benefits to others and thus created rivalry for the climate. This rivalry over the climate has instigated arguments over the allocation, management, and cooperative efforts required to solve equitably the climate change dilemma (Wiegandt 2001). Nevertheless, allocation disputes over rights to emit and limits to emissions, arguments concerning the most efficient and effective management solutions, and compliance and enforcement cooperation debates have been and should continue to be less contentious and more equitable under the influence of democratic norms, values, and procedures. Additionally, the legitimacy accorded agreements made by governments of the people and for the people should bolster the global societal acceptance of climate change policies (Russett and Oneal 2001). Another unique aspect of democracies involves democratic rules and procedures that produce legitimate governance.

Democracies promote transparent political rules and procedures that allow the free flow of information, enhance trust, and reduce uncertainty or fear (Russett and Oneal 2001). These shared democratic preferences revolve around common values and norms that set democracies apart from autocratic countries and enhance cooperation

among democracies (Doyle 1986; Kant 2001; Russett and Oneal 2001). Equity and normative conceptions of the future of the planet, both major liberal democratic concepts, are also major issues in climate change negotiations. Accordingly, the most contentious aspect of climate change equity issues are between developed and developing states (Wiegandt 2001). Only a rigorous, transparent, equity driven climate change negotiation process based on liberal democratic principles can deliver the necessary compromises and consensus needed to address these differential responsibility concerns. Additionally, the formal checks and balances, transparency of thought and deed produced by free speech, and open political contests concentrated in democratic regimes (Solingen 1996; Russett and Oneal 2001) make democracies distinctly qualified to address liberal concerns for justice, fairness, and equity inherent in climate change disputes.

Finally, the anxieties over externalities, focus on individual rights, and special attention to public goods localized in democracies has resulted in democracies being the most accomplished protectors of the environment compared to other political regimes (Gleditsch 1997; ESI 2000), notwithstanding the massive environmental degradation occurring in some developing democracies such as India (Sapru 1998). Further empirical evidence for this declaration has been supplied by numerous research studies of the environmental atrocities committed by the governments of former communist regimes like the USSR (Feshbach and Friendly 1992; Jancar-Webster 1993; Nikitina 1994; Feshbach 1995; Baker 1996) and current communists regimes, such as China (Hertsgaard 1998; Ma and Ortolano 2000).

In sum, only democracies have the liberal structural and cultural characteristics to counter the enormous social, economic, political, and environmental challenges that global climate change presents. Democracies have a political structure that encourages open debate and have internal checks and balances that prevent domination by special interest. Democracies also have norms, values, and principles that support freedom, accountability, legitimacy, equity, and justice. All critical elements needed to create a climate change regime that respects and accounts for the needs of all people of the world and will produce an equitable, fair, and just solution to the climate change challenge.

Economic interdependence

Expanded international trade has been promoted in the past as a remedy for war and as a catalyst for increased cooperation, prosperity, and peace (Kant 2001). Trade has been repeatedly touted because it is assumed to create common interests between states, encourage the development of international law and organizations, and because it advances economic interdependence (Russett and Oneal 2001). Liberals believe economic interdependence and autonomy-limiting cooperation from trade can help overcome the negative effects of international anarchy (Zacher and Matthew 1995). The shared values, commitment to terms of trade, regulation of capital flows, and the peaceful resolution of contractual quarrels as a result of strong economic ties provide order, structure, and thus limit the harmful effects of anarchy. International trade and economic interdependence issues are interwoven into the controversies and calculations permeating climate change negotiations.

The Kyoto Protocol contains several articles that are directly affected by international trade and economic interdependence concerns. The five flexibility mechanisms built into the Protocol are sometimes considered controversial processes designed to address international energy transactions and these energy transactions are core, essential exchanges within an interdependent global economy. Each mechanism was designed to give some form of flexibility to developed countries as they began to limit their production of greenhouse gases. Inherent in these mechanisms are market-based proposals that are conceived as the most suitable methods to allay economic and trade anxieties and account for “differing circumstances, responsibilities, and capabilities of the Parties and their respective commitments” (UNFCCC, Kyoto Protocol 1997, Article 13(4c)).

Article 2 of the Protocol allows sequestration of additional carbon in a variety of sinks as credit for emission reductions. The effects on international trade from this process may come in the form of transfers of new sequestration technology, development of joint reforestation or afforestation projects, or sharing of emerging and unique land use technologies (Soroos 2001; Bodansky 2001a). This approach benefits both developing and developed states by providing a variety of technological processes that sequester carbon from release into the atmosphere thereby reducing net emissions.

Article 12 creates the Clean Development Mechanism (CDM) which allows Annex I parties to earn credits for emission-reduction efforts in non-Annex I parties (Soroos 2001; Bodansky 2001a). In other words, this article specifically creates a means for industrialized states to receive emission reduction credits by financing projects in developing states. The CDM benefits the investing firm via the emission

credits and also benefits the developing state from the transfer of new technologies and the increased sustainability of its economy (Goulder and Nadreau 2002). The economic interdependence of the developed state and the developing state would also increase and possibly yield to more spill-over agreements, more collective gains, additional coalescing of state interests, and more cooperation and interdependence in other areas (Haas 1964; Keohane and Nye 1977). Additionally, the new avenues of trade will expose the developing state to the norms, values, ideas, and perspectives of the developed state and vice versa opening new channels of communication and conflict resolution (Russett and Oneal 2001). The CDM is also a negotiating tool that permits side-payments (transfers of resources) between the North and South that can be used to overcome possible vetoes from disgruntled negotiating parties (Wiegandt 2001). Overall, the CDM is potentially a win-win process.

Article 17 institutes an international emission trading regime, permitting Annex I parties to engage in emission trading, in addition to domestic action, with other Annex I states (Soroos 2001; Bodansky 2001a). Global emission trading among the states that have legally binding limits on emissions would be an enormous boost to international trade and would enable states to reduce emissions at a much lower cost than command and control systems.

Specifically, an international greenhouse gas emissions market would enable states and industries to confront the dilemmas of meeting emission reductions at the least cost, with the greatest flexibility, while maintaining international competitiveness (Petsonk, Dudek, and Goffman 1998). As an added feature, any state that does not have a legally binding emission limit may adopt one and then will be allowed to fully

participate in the emissions trading regime (UNFCCC, Kyoto Protocol 1997, Articles 20 and 21). Another flexibility mechanism in the Protocol permits states with legally binding emission limits to enter into joint projects with other states with legally binding emission limits that overall yield emissions reductions.

Article 6 enables creation of Joint Implementation (JI) projects where Annex I countries or firms can earn emission reduction credits by investing in mitigation projects in other Annex I states (Soroos 2001; Bodansky 2001a). The projects must provide emission reductions that are “additional” to any domestic emission reductions that would otherwise occur. The Protocol also does not differentiate accounting wise from emission trading and emission reduction projects. Joint Implementation offers a process whereby some of the less advanced industrialized states could acquire the most advanced emission reduction technologies at the lowest costs (Goulder and Nadreau 2002). This mechanism is very similar to emissions trading in that it encourages emissions reductions where they can be implemented at the lowest cost, both parties benefit, and each states’ overall emissions target is reduced. The fungibility of JI processes help ensure that sellers and buyers of emissions reductions are not constrained and can transact freely, only having to comply with requirements that ensure the environmental legitimacy of the traded reductions. In contrast, anything that restricts emission trading reduces the incentives for entrepreneurs to create new, innovative, and cost-effective methods for reducing emissions and ultimately hinders the environmental effectiveness of the climate change regime (Petsonk, Dudek, and Goffman 1998). A final method to provide pliable avenues for reducing greenhouse emissions, with economic interdependence implications, is the creation of joint commitments.

Article 4 allows any group of Annex I states to pool their assigned emission reduction limits so that they can fulfill their commitments jointly (Soroos 2001; Bodansky 2001a). This proposal allows states that have been assigned legally binding emissions limits to implement their obligations collectively, by way of bubble or umbrella arrangements (Petsonk, Dudek, and Goffman 1998). A collective arrangement allows states that have less advanced greenhouse gas emission reduction technologies time to upgrade while states with the more advanced technologies absorb higher emission reductions. As an added protection, the Protocol also provides a rigorous accounting system that ensures that if the collective group fails to meet its total combined commitment level then each party in the collective must meet its own individual emission reductions (UNFCCC, Kyoto Protocol 1997, Articles 4, 3.10, 3.11, Annex B, and UNFCCC Annex I). This article should increase the economic interdependence within the bubbles and enable burden sharing of emission reductions. The benefits of free trade also should be evident not only within bubbles but among individual states globally.

Fair, competitive, and open trade policies are particularly important in correcting the adverse effect of market failures. Market failures occur when some but not necessarily all of the following are unevenly distributed: information, transaction costs, trade barriers, scarce common property resources, public goods, and externalities (Zacher and Matthew 1995). International free trade can help overcome market failures if international market policies are based on democratic institutions, international laws and organizations, and liberal economic principles. Open, transparent commercial arrangements, sharing financial information and transaction costs, eliminating tariffs or

quotas, regulating sustainable use of common resources, providing for equitable allocation of public goods, and accounting for externalities in economic calculations are all processes that liberal democracies and international organizations can support, enforce, and expand. As a result, the third leg of the Kantian triangle, international organizations, is intricately involved in climate change debate, decisions, and policymaking.

International organizations

International organizations (IOs) have exploded in number since the end of World War II (Russett and Oneal 2001). IOs like the UN, the European Union (EU), the World Trade Organization (WTO), the International Monetary Fund (IMF), or Greenpeace are increasingly affecting the domestic and international governance of global society (Pease 2000). International organizations are often grouped as Intergovernmental Organizations (IGOs like the UN), Non-Governmental Organizations (NGOs like Greenpeace), and Multi-National Corporations (MNCs like Exxon-Mobil). All of these differing forms of IOs provide for certain needs often created by the interaction between liberal democratic and economic interdependence concepts. Trade, capital flows, investments, labor management, services control, ecosystem management, and other varied international activities have been improved, consolidated, simplified, regulated, and facilitated by IOs. In particular, IOs are often asserted to support democracies and economic interdependence through the actions of several distinct positive functions (Russett and Oneal 2001). These functions are also evident in the processes to establish an international climate change regime.

Kyoto Protocol negotiators continue to work toward processes that will keep states from free riding, cheating, or violating the norms of behavior established by the Protocol. Using additional pressures, such as shaming, interest group influences, compliance incentives, subsidies, and side payments (Dannenmaier and Cohen 2000; Wiener 2002), the Protocol as a “de facto transnational coalition” has had “enormous influence” on international cooperation (Lee 1995, 14). The climate change regime has established an extensive and elaborate system of national reporting and international review (Wiener 2002) and as more monitoring procedures are built into the regime, conditional cooperation will increase as free riders become easier to detect (Levy, Keohane, and Haas 1993). In reality, the payoffs that an individual state would receive from free riding would be greatly reduced if the majority of states adhered to the Protocol’s agreements and this decrease in incentives to cheat should further enhance global cooperation (Axelrod and Keohane 1985). However, since the program currently relies primarily on self-reporting these processes fall short of a strict verification system needed to prevent free riding and cheating (Wettestad 1991; Bodansky 2001a). Additionally, the Protocol has no provisions for sanctioning non-compliers and is currently relying on the potential of trade sanctions from the GATT and WTO, and some scholars see the probability of applying these trade penalties to be very low (Bodansky 2001a). Consequently, coercing norm-breakers may be a weak area of the current climate change regime and new programs are being worked on that ensure compliance, verification, and enhance enforcement (Dannenmaier and Cohen 2000; Sprinz and Weiss 2001). International organizations can also function as conflict mediators, problem-solvers, and as inclusion mechanisms.

The basic 1992 FCCC contains the vestiges of conflict mediating systems that are very similar to other international environmental agreements. The parties to the convention are expected to develop a “multilateral consultative process” in case of disputes and to use the expert advice of the technical, scientific, socio-economic, and legal working groups that are assigned to assist the Conference of the Parties (COPs) (UNFCCC, Kyoto Protocol 1997; Bodansky 2001). Many of the procedures for dispute resolution are modeled on the highly successful Montreal Protocol on stratospheric depletion (Bodansky 2001). In addition, the secretariat of the UNFCCC has broad powers to communicate information, coordinate activities/meetings, and to perform diplomatic functions that can build trust and reduce conflict and enable states to meet their regime obligations (Levy, Keohane, and Hass 1993; Grundig, Ward, and Zorick 2001). Article 14 of the UNFCCC specifically describes dispute settlement procedures for Party members and recommends Parties submit disputes to the International Court of Justice and/or to arbitration and if necessary describes procedures for creation of a conciliation commission to resolve the dispute (UNFCCC 1992). Furthermore, IOs often fulfill the vital functions of problem solving, expanding a state’s self-interest concepts, and the function of uncertainty reduction by providing pertinent information (Russett and Oneal 2001).

The technical, scientific, and legal working groups that are assigned to assist the Convention’s COPs are responsible for answering common problems, investigating technical/scientific issues, and expanding the overall knowledge base of all COP members. The highly complex nature of climate science has made the reports the IPCC

working groups produce very valuable to the climate change regime as tools for problem solving.

The IPCC reports have investigated issues such as: the scientific basis for climate change; impacts, adaptation and vulnerability to climate change; climate change mitigation; sustainable development and climate change; and a host of technical issues, assessment problems, methodology concerns, and have provided detailed summary and assessment reports for policy makers (IPCC 2001). As a whole these reports have provided decision makers from every state an analysis of the impacts that global climate change will have on their state and suggestions for mitigation and adaptation responses. The reports have emphasized, as has the Protocol, the common but differentiated responsibilities of every country for their greenhouse gas emissions and the obligation of developed countries to limit their emissions as soon as possible (UNFCCC Kyoto Protocol 1997; Paterson 2001). As a consequence, the reports have established a sense of global self-interest and inclusion by explaining the pressing requisite for international efforts to mitigate and adapt to climate change (UNFCCC, Kyoto Protocol 1997).

The IPCC reports, the international news media, and the climate change regime process have also created a sense of common identity as many citizens worldwide are now fully aware of the global threats that climate change creates and the process has animated a perception that all states are in this together (Dunlap, Gallup Jr., and Gallup 1993; Luterbacher and Sprinz 2001; Schneider, Rosencranz, and Niles 2002). Most researchers and policy makers have concluded that a global environmental space, the atmosphere, must be centrally controlled, and global rules for its use and allocation must be debated, concluded, and obeyed (Baer 2002). Consequently, climate change

now looms large as the major reference point for all discussions of global environmental change and its impacts on humans. Another very important role of international organizations is to encourage socialization among members and to shape group norms.

The entire climate change regime encourages socialization by fostering open channels of communication, stimulating debate among the parties, and institutionalizing accountability for climate change. Liberal norms of fairness, equity, justice, economic efficiency, liability, differential responsibilities, and capacities are inherent in the UNFCCC, the Kyoto Protocol and in the negotiating process (UNFCCC 1992; UNFCCC Kyoto Protocol 1997; Kerr 2001; Wiegandt 2001; Wiener 2001; Agarwal 2002; Baer 2002). The regime designed to resolve the climate change debate has evolved into a strong international governmental organization that incorporates many of the qualities of successful international organizations.

The climate change regime is developing strong yet flexible processes to coerce norm-breakers and to enforce compliance with regime articles (Dannenmaier and Cohen 2000; Bodansky 2001a; Mitchell 2001). The regime already has acceptable conflict resolution processes and has embedded democratic norms and values in many policies and articles. For example, democratic norms of accountability, legitimacy, and transparency have been incorporated prominently in the UNFCCC and the Kyoto Protocol (UNFCCC 1992; UNFCCC Kyoto Protocol 1997). The entire information gathering and disseminating process is open, comprehensive, based on state-of-the-art science/technology, and as a result reduces uncertainty, mistrust, and suspicion among the Parties (IPCC 1998). A by-product of the information gathering process is an

abundance of issue specific reports, assessments, and summaries that are excellent decision-making tools. Many reports focus on the effects of climate change on state and international economies (IPCC WG III 2001). As the regime has evolved, liberal norms of equity, justice, and economic efficiency evoked by climate change dilemmas, have been socialized, deliberated, and incorporated into climate change discussions and solutions (Paterson 2001; Wiegandt 2001; Agarwal 2002; Baer 2002).

Finally, the process of creating a climate change regime along with the emergence of new signals of global climate change itself have interacted to bring the climate change problem to the forefront of global public opinion concerns (Dunlap, Gallup Jr., and Gallup 1993; Dunlap and Mertig 1997; Luterbacher and Sprinz 2001; Schneider, Rosencranz, and Niles 2002). Climate change is not just a developed country problem and is not a controversy that can be overlooked by developing states either. As someone once stated “we all have a dog in this fight.” The climate change regime has become a vital instrument for liberal democratic diplomacy, economic policy making, and peaceful conflict resolution. The realist - liberal debate also has one more prominent concept that deserves investigation and analysis.

Relative and absolute gains

Some realists and most neorealists in particular contend that concerns for relative gains will dominate international negotiations and lessen the possibilities for cooperation (Grieco 1988). Conversely, liberals focus on the absolute gains from mutual transactions and cooperative endeavors. However, scholars of this debate have determined that the disagreement is not as straightforward as some would argue. Some

scholars have proposed that relative gain concerns are dominant factors only when the probability of military conflict is elevated. When military conflict probabilities are not elevated, interests in absolute gains will guide strategic calculations (Powell 1991).

This strand of thought leads to the conclusion that security interests drive relative gains anxiety and economic interests drive the focus on absolute gains (Lipson 1984).

Expanding on this line of thinking into climate change issues leads to a different, more liberal understanding of the relative/absolute gains debate.

The efforts to mitigate and adapt to global climate change, as stated before, have enormous social, political, economic, and environmental challenges. The debate about the *effects* of climate change involves social, political, economic, and environmental aspects but the debate about *solutions* to climate change are predominantly carried out through the economic and technological analysis of climate change policy (Weyant 2000).

The current solutions to climate change offered by most scientists and policy-makers predominantly feature a global shift away from fossil fuels as the world's primary energy source (Toman et al. 2001). It would be prudent to describe the climate change issue as a global environmental problem in search of a global economic solution. Solutions are available right now, one is to do nothing and simply adapt to the warmer climate and its side effects (Bailey 1993; Jones 1997; Michaels and Balling 2000), but this approach has lost significant legitimacy as more recent studies by the IPCC and other climate scholars have concluded greater warming ranges and increased negative effects of climate change (NAST 2000; NRC 2001; IPCC WG I, 2001). The heart of the current global debate now centers on the costs of various solution strategies.

If the international relations scholars investigating relative gains are correct then the concern for how gains are used is misplaced because finding a solution to the climate change dilemma is not predominantly a security issue, but an economic and technological challenge (Lipson 1984; Powell 1991). In addition, researchers have determined that as the number of number of states interested in international cooperation increases, the effects of relative gains on the possibility of cooperation decreases, all things being equal (Snidal 1991). Specifically, as the number of states that are cooperating increases the concerns for relative gains is now distributed across more states and the subsequent impact of relative gains is also distributed among more states and is dramatically lessened. Accordingly, as a global problem requiring a global solution the number of states that are needed for a successful climate change solution is quite large. Therefore, relative gains from an economically and technologically dominated dilemma such as global climate change involving over one hundred states, should not be a factor, the relative negative impact of gains will be widely distributed and weakened, and consequently most state interests will shift to absolute gain concerns (Lipson 1984; Powell 1991; Snidal 1991).

Conceptions of Current International System – Summary

Realists view the current international system as anarchic, insecure, and dominated by power concerns. The exclusive focus by realists on security, war, and peace leaves little room for other international or domestic interests like environmental problems. In the conflict dominated world of realists zones of disputes have arisen in regards to climate change negotiations that have slowed cooperation and agreements.

Ratifiers, non-ratifiers, North, South, developed, developing, all are single mindedly concerned about relative gains and free-riders if a realist analytical approach is applied. Liberals, however, view the situation somewhat differently.

Liberals contend that cooperation under anarchy is possible and is occurring in greater frequency. States that stress democratic procedures and depend on economic interdependence to lessen the concerns for relative gains and free-riders will point to the proliferation of international organizations and the power of trade worldwide as proof that global cooperation can expand and that other issues in addition to security concerns are important. Liberals view environmental problems and particularly global climate change as both a threat to global prosperity and freedom but as an opportunity to apply Kant's pillars in the pursuit of peace and prosperity.

Realist and Liberal Worldviews and Global Climate Change – Conclusions

Scholars of international relations have often discussed the characteristics of a theoretical realist world and a theoretical liberal world. A hypothetical realist world is dominated by territory, sovereignty, security, power, and war interests (Morgenthau 1978; Waltz 1979; Onuf and Johnson 1995). A hypothetical liberal world is dominated by free trade, interdependence, prosperity, freedom, and peace interests (Onuf and Johnson 1995; Hughes 1997). Which depiction above more accurately describes or explains the climate change challenge? Which worldview offers a practicable or feasible solution?

The core assumptions of realism and liberalism are applicable to the climate change debate, but with varying degrees accuracy and completeness. Both the realist

and liberal worldview explain and describe aspects of the climate change challenge but the realist worldview is less accurate and complete. The deductive approach of the neorealists does not adequately accommodate the normative dimensions of climate change discussions of equity and justice concerns. Also, realism in general, is limited in its descriptive and explanatory powers by the narrow range of central motivations that make up realism's core assumptions.

Realists are primarily concerned with security, power, and autonomy. All realist interests revolve around these major concerns. Realists contend that many states are concerned that mitigation and adaptation costs from climate change will affect their relative power positions in the global hierarchy, threatening their security or survival. However, the security or survival of the most powerful states in the international system will not be threatened by global climate change. Realist explanations and assumptions do not go far enough to accommodate the expanded preferences of states and non-state actors that dominate the climate change debate. Climate change will progressively threaten the freedom and economic well-being of individuals, groups, non-state actors, and states, consequently a state centric approach is incomplete. Additionally, a worldview that does not address change but relies on predictions of repeating historical cycles is incapable of rectifying an evolving, dynamic, non-linear challenge to global society. Also, a worldview that is only focused on the causes of war and peace has limited applicability to a multidimensional social, political, economic, and environmental threat. Finally, when realists contend that anarchy always limits international cooperation they ignore the amazing cooperative efforts that make the European Union a pacific confederation of states with varied and sometimes conflictual

interests. The broad coalition represented by the EU which incorporates the structural components of the democratic peace can be a basis for an international climate change regime that can effectively address the worldwide implications of global warming and tame the security dilemma demons that arise from anarchy.

Climate change mitigation and adaptation may require arduous, perhaps harsh policies that could engender resistance, may be unpopular, and could be difficult to carry through. Successful policy implementation would require operationalization of consent and must be viewed by global society as legitimate. Only a democratic policy-making process can legitimize the needed plans of action and secure the necessary level of commitment for a favorable outcome. Only an international climate change regime, incorporating democratic principles, advocating market based, free trade solutions can overcome the global warming threat. But a shift in thinking must occur.

The realist paradigm must give way to liberal policies and thinking. Realist concerns for security, power, and autonomy must be assuaged by belief in the pacific effects of democratic regimes, international organizations, and economic interdependence. States must focus on the freedom and well-being of their people and trust the democratic peace and the three pillars of Kant's perpetual peace proposal to solve the global climate change challenge. No other worldview accurately and completely explains or describes the climate change dilemma and no other worldview offers a sufficient, global solution. The existing rules of the dominant realist paradigm do not answer climate change puzzles, discrepancies between theory and fact abound, and consequently climate change may create a crisis in the political science community (Kuhn 1962, 68-69) that could enable the emergence of the liberal paradigm.

CHAPTER IV

DISEQUILIBRIUM BETWEEN HUMAN SOCIAL SYSTEMS AND NATURAL ECOLOGICAL SYSTEMS

Introduction

The relationship between human social systems and natural ecological systems is currently out of balance and could become even more unstable as a result of global climate change. As a result, a dramatic paradigm shift from the predominant industrially based social paradigm to a new environmentally focused social paradigm may rapidly occur this century. Currently, a spectrum of social environmental theories exist describing and explaining the relationship between humans and the natural environment and this spectrum is constantly being modified and updated. The prevalent view has been described as the dominant social paradigm (DSP) and the main points are as follows:

The main theme underlying the dominant social paradigm is that economic growth, international trade, and continuing innovations in science and technology will continue to improve the human condition by reducing poverty and increasing the relative equality among nations. Population growth is seen as a primary means to increase consumption and production capacity simultaneously, thus stimulating economic growth. Capital accumulation and strategic investment in general, and the maintenance of open markets in particular, are seen as the best means of promoting economic growth. Proponents of this approach typically oppose planning, especially by governments, viewing legally sanctioned plans as creating unwarranted constraints on entrepreneurial activity and establishing faulty prices on goods and services in commerce (Steel, Clinton, and Lovrich 2003, 11).

This perspective is also considered to permeate advanced industrial societies and is considered the major influence on governmental decision making in developed states because it is the basis for the public policy beliefs and values of most of these state's leaders (Steel, Clinton, and Lovrich 2003). Inherent in this perspective is an anthropogenic outlook where humans are the primary entity on the planet (Steans and Pettiford 2001). In this vein, environmental policies and resource management functions should be designed to maximize production of goods and services for the benefit of humans and human societies, regardless of the environmental impacts (Steel, Clinton, and Lovrich 2003). Natural systems are considered resilient and anthropogenic activities supported by advanced technological capabilities are assumed incapable of completely destroying major natural ecological systems (Bailey 1993; Simon 1996; Lomborg 2001). According to the guidelines of the anthropocentric dominant social paradigm, global climate change will not permanently affect the durable Earth and any negative impacts of climate change can be overcome in short order by ingenious technological innovations (Simon 1996; Lomborg 2001; Steel, Clinton, and Lovrich 2003). On the other hand, not everyone interested in global warming shares the optimistic assessment of the climate change dilemma advocated by dominant social paradigm supporters.

In response to international concerns for and mounting evidence of the degradation of global water resources, the degradation and desertification of land, the exhaustion of biodiversity, the pollution of waterways and the atmosphere, and the deleterious consequences of global climate change, a new general social environmental paradigm has emerged over the last two decades (Curran 2001; Steel, Clinton, and

Lovrich 2003). Much of the concern for, research into, and evidence that the global environment is rapidly deteriorating emanated from the post-industrialized states in concert with the emergence of new, environmentally concentrated social theories (Dunlap and Van Liere 1978, 1984; Brown and Harris 1992; Milbrath 1993; Dunlap and Catton 1994; Mol 2002). Subsequently, a general environmental paradigm appeared that is predominantly focused on conserving and protecting the last remaining undisturbed or recoverable ecosystems (Steel, Clinton, and Lovrich 2003). The major supporters of this perspective plead for a:

...deep concern over population growth and current rates of natural resource consumption. They argue that unrestricted population and unplanned economic growth will have deleterious long-term consequences for the Earth and all its living inhabitants. They argue that climate change, stratospheric ozone depletion, loss of forested lands, and similar developments could lead to catastrophic environmental events unless people mend their wasteful, and too often, inconsiderate ways. New environmental paradigm advocates maintain that we must plan for the future we want, and we must promote cooperation among the people and nations of the world to carry out these plans (Steel, Clinton, and Lovrich 2003, 11).

The new environmental paradigm stresses the interdependence within distinct ecosystems of all creatures on the planet, a concept that is not fully developed or understood, but must be researched further in order to understand its complexity, relevance, and potential limits (Milbrath 1993). Advocates of this perspective point out that the link between environmental degradation and poverty is often overlooked as pressures for economic growth sometimes overwhelm social, political, economic, and environmental subsystems (Ehrlich 1968; Meadows 1972; Curran 2001). New environmental paradigm advocates are concerned that powerful new technologies such as genetic engineering, nuclear energy, and nuclear and biochemical weapons could be misused or mishandled resulting in a catastrophic global accident (Beck 1992, 1996;

Lash, Szerszynski, and Wynne 1996; Steel, Clinton, and Lovrich 2003). Also seen in this light is the global climate change dilemma, a product of the rapid and often environmentally destructive industrialization of states around the world.

The conflict between the dominant social paradigm (DSP) and new environmental paradigms (NEPs) has evolved. The DSP continues to rely on science and technology to cultivate economic growth while downplaying or ignoring environmental degradation problems. The concept of “corporate greening,” inherent in corporate environmentalism, the environmental variant of the dominant social paradigm, has been critiqued as just “green spin” by some (Beder 1998) and as an unnecessary program crafted in response to environmental alarmists by others (Bailey 1993; Simon 1996; Lomborg 2001). In contrast, one version of the new emerging environmental perspective, ecological modernization focuses on reforming the antagonistic relationship between capitalism and environmentalism by analyzing the environmental origins and environmental consequences of social change (Curran 2001; Mol 2002). Ecological modernization aims to create social institutional reformation processes that will preserve the sustenance base of natural resource systems (Mol 1996).

A second version of the NEP advocates radical restructuring of the global capitalist society and the international political economy (Pepper 1985; O’Connor 1991, 1996; Goldfrank, Goodman, and Szasz 1999). This viewpoint contends that market interchanges have come to dominate almost every process of decision making in modern societies, at the expense of clean air, water, and land (Pellow, Schnaiberg, and Weinberg 2000). In conjunction with these developments, the effect of global climate change on the social/ecological disequilibrium can be analyzed using these three major

environmental social paradigms: corporate environmentalism, ecological modernization, and radical environmentalism.

Table 4. Core Assumptions of Contrasting Environmental Social Paradigms (Modified from Hajer 1996; Hughes 1997; Mol 2002; Gibbs 2003)

Characteristics	DSP or Corporate Environmentalism	Ecological Modernization	Radical Environmentalism
Agents	The "Firm"	Economic and Political Institutions, Environmental Movements	Economic Classes, The State, Environmental Movements
Emphasis	Maintenance of Status Quo	Institutional Reformation	Social, Political, Economic, and Environmental Transformation
Central Concepts	Economic Conservatism, Economic and Environmental Spheres are Separate	Realistic Reconciliation Between Environmental and Economic Spheres	Treadmill-of-Production, The Second Contradiction of Capitalism
Primary Outputs	Business as Usual, Economic Growth, Prosperity	Relative Improvements, Continued Growth	Absolute Sustainability
Typical Forecasts	Continued Economic Growth is Non-Threatening to Ecological Systems	Real Changes, Economic Growth, Environmental Improvements	Window Dressing Masks Potential Cataclysm

The following analysis investigates which social environmental paradigm is most descriptive, predictive, and applicable in relation to global climate change. It is assumed that international action taken to mitigate or adapt to global climate change could compel replacement of the dominant social paradigm by a new ecologically

sensitive social paradigm as the most descriptive, predictive, and applicable theory.

Specifically, the theoretical propositions that will be analyzed are:

1. The dominant social environmental paradigm, corporate environmentalism, is more applicable to global climate change discussions, responses, and solutions than the new environmental paradigms.
2. The new environmental social paradigm, ecological modernization, is more applicable to global climate change discussions, responses, and solutions than the dominant social paradigm or the radical environmental paradigm.
3. The new environmental social paradigm, radical environmentalism, is more applicable to global climate change discussions, responses, and solutions than the dominant social paradigm or the ecological modernization paradigm.

Corporate Environmentalism and Global Climate Change – Introduction

The dominant social paradigm's environmental aspect is expressed in the form of corporate environmentalism. Corporate environmentalism focuses on the adoption of environmentally friendly practices and procedures and the recognition of increased environmental responsibilities by individual business firms (Perry and Singh 2001; Gibbs 2003). The "greening" of business firms does not come at the expense of profits, market shares, economic growth, or business as usual and corporate activities remain essentially environmentally destructive (Beder 1998; Gibbs 2003). Environmental destruction is just an external cost of doing business and the destruction is not considered permanent or irreversible (Bailey 1993; Simon 1996; Lomborg 2001). As a consequence, this paradigm does not see a need to reconcile economic needs with natural, ecological concerns. In addition, some companies have been accused of "greenwash," co-opting environmentalism into mainstream capitalism, "spinning"

environmental problems into non-threatening issues, or marginalizing green movements that refuse to be co-opted (Bridge and McManus 2000; Gibbs 2003). Nevertheless, some companies have incorporated into their standard business processes such activities as procedures to reduce pollution, decreased resource-intensity methods, environmental management systems, and environmental auditing and successfully reduced some forms of pollution, waste, and improved some indicators of environmental quality (Rondinelli and Berry 2000; Gibbs 2003). In this respect, corporations are paying increased attention to environmental issues for a variety of reasons to include the following three broad motives.

First, corporations may contend that there is a strategic advantage to be gained by utilizing green business practices. Here the primary driver is the conviction that being environmentally cleaner will reduce costs and increase market share. Companies also recognize side benefits of appearing more environmentally sensitive in the form of enhanced corporate reputations, a more positive public image, additional “good” publicity, and increased customer loyalty (Rondinelli and Berry 2000; Perry and Singh 2001).

The second potential rationale for going green is that companies wish to avoid the disadvantages of not going green. Many corporations desperately want to stay clear of the negative impacts on equity values and public reputation and the financial penalties that illegal environmental transgressions can impose (Rondinelli and Berry 2000; Perry and Singh 2001).

Finally, the third possible motive driving corporate environmentalism is the desire by companies to act responsibly. The drivers for responsible actions may be

primarily profit induced or they may be invoked by a need to establish legitimacy in the eyes of consumers, the public, or government. In particular, many international firms increasingly want to be perceived as acceptable, clean, and environmentally sensitive by global society and by their stockholders (Rondinelli and Berry 2000; Perry and Singh 2001). Accordingly, the climate change dilemma poses an enormous challenge to the advocates of corporate environmentalism around the world.

Agents

Researchers investigating corporate environmentalism view the firm as the basic agent and as such focus on the individual achievements and activities of firms. In relation to global climate change, anthropogenic CO₂ emissions come from two primary sources: (1) the combustion of fossil fuels, and (2) land use change, primarily tropical deforestation (IPCC WGI, 2001). The emission levels depend on the size of human populations, economic activity levels, and on the technologies in use. Economic activity is closely tied to the levels of energy use. Corporate firms are the backbone of economic activity and consequently energy use. Electricity producing companies emit 42% of the global CO₂ emissions; transportation activities emit 24% of global emissions, industrial firms 20%, and residential and commercial activities 14% of the global CO₂ emissions (IEA 2000). As a result, the agents of corporate environmentalism, firms are major actors in the climate change debate.

As an illustration, one of the most powerful recent representatives of corporate environmentalism, an anti-climate change alliance of major fossil fuel reliant industries, the Global Climate Coalition had a profound effect on climate change negotiations in

the US and internationally. The Global Climate Coalition's early membership included some of the world's most powerful trade associations and MNC: BP-Amoco, the American Forest & Paper Association, American Petroleum Institute, Chevron, Chrysler, Cyprus AMAX Minerals, DaimlerChrysler, Exxon, Ford, General Motors, Royal Dutch/Shell, Texaco, and the United States Chamber of Commerce. Prior to the Kyoto Summit in 1997, the Coalition spend an estimated \$13 million on an advertising campaign that focused on the prospect that policies derived from the Kyoto Protocol would create high rates of unemployment and double gasoline prices (Agrawala and Andresen 1999; Rosencranz 2002). Additionally, the Coalition helped fund and publicize contrarian climate change research by a handful of scientists, most with problematic expertise in climate change science (Agrawala and Andresen 1999). The Coalition is credited with helping to keep the Kyoto Protocol from being sent to the US Senate for ratification in 1997 and for sponsoring legislation that would undermine any attempts to reduce greenhouse gas emissions (McCright and Dunlap 2000). Internationally, the main purpose of the Coalition was to cast doubt on the theory of global warming and to oppose any government policies which sought to reduce or regulate greenhouse gas emissions. The Coalition attempted to apply all of the strategic advantages identified earlier.

The corporations in the Coalition foresaw major positive benefits from maintaining the energy production from fossil fuels and attempted to portray the Coalition as an organization responsibly looking out for the needs of the people by identifying and protesting the loss of jobs, profits, and competitiveness that would naturally ensue, the Coalition contended, from a ratified Kyoto Protocol. The Coalition

also wanted to avoid the extensive economic disadvantages from profit losses and market share declines as a result of internationally regulated emission reductions. Recently, however, many powerful and prominent members have left the Coalition to include American Electric Power, BP-Amoco, Dow, Dupont, Royal Dutch/Shell, Ford, Daimler Chrysler, Southern Company, Texaco and General Motors. Ford Motor Company Chief Economic Officer William Clay Ford, Jr. explains why his company left the Global Climate Coalition: “The present risk is clear. The climate appears to be changing, the changes appear to be outside natural variation, and the likely consequences will be serious. From a business planning point of view, that issue is settled. Anyone who disagrees is, in my view, still in denial” (Ford 2000). Again, the principal concerns are the strategic interests of corporations to maintain profit margins and market shares. Corporations have now observed the dialogue on climate change advance from one of denial of global warming to acceptance of global climate change and many firms have strategically positioned themselves in order to economically take advantage of any future regulations on greenhouse gas emissions (Hawken, Lovins, and Lovins 1999). International corporations individually continue to apply the strategic considerations of corporate environmentalism, which dictate if looking green creates a positive public image, saves costs, or prevents losses, then looking green is good for business.

While many firms have achieved much individually using cleaner production concepts and emphasizing eco-efficiency via reduced material inputs and waste production their capacity to coordinate and cooperate at a sufficient level to tackle a global environmental problem such as climate change in a constructive manner is very

suspect (Gibbs 2003). A social theory conception that focuses exclusively on the activities of individual corporations may be unable to engage a global issue of the magnitude of climate change. State actors are currently one of the crucial driving forces in climate change negotiations (Rowlands 2001). Also non-state actors like NGOs, environmental movements, and epistemic communities have been and continue to be prime influences on climate change policies and decisions (Raustiala 2001). Ignoring the impact of the political and social institutions actively involved in debating climate change issues substantially weakens the corporate environmentalism paradigm. In essence, the diverse interests of the multiple agents involved precludes independent, distinct, or unilateral application of climate change remedies and invalidates portions of the corporate environmentalism paradigm in reference to global warming.

Emphasis, Central Concepts, and Primary Outputs

The dominant environmental social paradigm represented by corporate environmentalism basically maintains a conventional approach with respect to social change, focused on affirming the centrality of economic growth by ensuring business and industrial markets are free from social, political, or environmental interferences. As a result, corporate environmentalism endorses dominance of economic considerations over ecological concerns in an insular drive for larger profits and market shares. In this respect, human needs are often considered isolated from ecological needs and the exceptional capabilities of humans allow industrialized societies to be unimpeded by

sustenance limits (Dunlap and Catton 1994). Nevertheless, this traditional approach to social change does reflect some of the contemporary dynamics of and influences on global climate change discussions.

As reported earlier, the Global Climate Coalition was very successful in defeating attempts to ratify the Kyoto Protocol and in passage of anti-climate change legislation. The Coalition was also supported by anti-environmental segments of the American conservative movement. The American conservative movement is argued to be strongly supportive of traditional ideals about humans and nature that frame the dominant social paradigm (Dunlap and Van Liere 1978, 1984; Steel, Clinton, and Lovrich 2003). An extension of the dominant social paradigm in the US is the concept of “Manifest Destiny,” where human well-being depends on the unhindered processing and conversion of natural resources into goods for human consumption (Brulle 2000; McCright and Dunlap 2000). The dominant social paradigm, Manifest Destiny, and specifically corporate environmentalism all include core elements of the conservative ideology.

Conservative values such as support for the predominance of individual freedom, private property rights, laissez-faire government, and endorsement of free enterprise are intrinsic to the dominant social paradigm, Manifest Destiny, and Corporate Environmentalism (McCright and Dunlap 2000). Openly, the US conservative movement used three major counter-claims to confront the framing of global warming by the environmental movement: (1) the conservative movement claimed that the scientific evidence of climate change was weak, (2) conservatives contended that the net effect of global warming would be beneficial if it occurred, and

(3) conservatives argued that the policies proposed to mitigate and adapt to climate change would be more harmful than beneficial (McCright and Dunlap 2003). At least in the US, climate change policies and environmental protection commonly are viewed as threats by many conservatives to individual freedoms, private property rights, laissez-faire government, and free enterprise or in general, the “American way of life” (McCright and Dunlap 2000, 2003). In particular, the Kyoto Protocol has been heavily criticized by many conservatives for introducing excessively aggressive timetables for reducing global greenhouse gas emissions that would not be cost effective or cost efficient, and would harm traditional American conservative values.

Industrial nations that ratify the Kyoto Protocol are committed to national greenhouse gas emission ceilings and these targets are legally required to be reached during the commitment period 2008-2012. The flexibility mechanisms in the Protocol authorize emission trading between developed states (Article 17), the use of emission trade bubbles (Article 4), and international transfers of new technologies and financial assistance in return for additional emission credits (Article 12). Nevertheless, the flexibility mechanisms are tied to an assertive time table designed to reduce emissions for all industrialized states to 5.2% below 1990 emission levels by 2012 and regardless of how the mechanisms are applied there will be international costs. Selected studies of the international flexibility mechanisms designed into the Kyoto Protocol indicate the mechanisms may reduce costs of reaching global emission targets by more than 50% (Goulder and Nadeau 2002), while other studies claim that emission reduction costs for the US alone would be 1%-2% of the US's GDP each year (Shogren and Toman 2001).

The disparity between the studies' findings often revolves around how the studies account for certain risks: uncertainty, irreversibility, and catastrophic climate change (Shogren and Toman 2001).

Studies that concentrate more on the somewhat better understood economic implications of climate change tend to see higher international costs for global emission reduction efforts. However, studies that spotlight the environmental and social impacts naturally evaluate more of the less certain direct and supplementary benefits from mitigating climate change and these benefits tend to counterbalance some of the economic costs (Weyant 2000; Burtraw and Toman 2001). Consequently, a social paradigm that places a significant priority on economic criteria, such as corporate environmentalism, may insufficiently and detrimentally regard environmental factors. Also, an effective global climate change regime should consider not only economic costs but social, political, and environmental expenditures. In line with the conservative approach of corporate environmentalism are conventional economic proposals to modify the Kyoto Protocol.

Climate change is acknowledged to be a long-term challenge in need of a comprehensive solution that resolves mitigation, distributional, and adaptation questions (Toman 2001b). Many researchers counsel a conservative integrated approach to climate change with policies that reduce emissions slowly at first, and then gradually increase required emission reductions over time (Kolstad 1996; Wigley, Richels, and Edmonds 1996; Manne and Richels 1997; Toman 2001a; Smith et al. 2002). Advocates argue this scheme would minimize negative effects on economic growth and permit businesses and industries to adapt, innovate, and acclimate to gradually increasing

restrictions on emissions. Consequently, business as usual would not be noticeably affected by this approach and this program has found much support from conservative corporate entities.

Typical Forecasts

Corporate environmentalism is a social model that views nature as durable, indestructible or repairable using the robust technological and scientific capabilities found in plentiful quantities within ingenious and exceptional industrial societies (Dunlap and Catton 1994; Simon 1996). In concert with this view is the outlook that environmental problems are not a threat to the prosperity, freedoms, and economic welfare of most global citizens (Bailey 1993; Lomborg 2001). Climate change is viewed by some protagonists of this paradigm as a possible boon to mankind and certainly not a threat to global society (Bailey 1993; Moore 1998; Michaels and Balling 2000).

The IPCC predicts warming of anywhere from 2.2°F - 10°F (1.4°C - 5.8°C) by the year 2100 (IPCC WGIII, 2001), while a small group of corporate funded climate change skeptics predict only a 2.3°F (1.3°C) rise in global temperature by the end of the 21st century (Michaels and Balling 2000). The skeptics predict the smaller increase in global temperatures could yield more moisture and less drought and they do not foresee increases in floods or severe weather conditions, like hurricane, cyclones, and tornadoes. These skeptics even predict that by 2050 the increased crop yields caused by enhanced CO₂ fertilization could alone feed one-quarter of today's world (Michaels and

Balling 2000). Optimistically, the skeptics conclude that most of global warming should occur in the very cold regions of Siberia and Northwestern North America.

In a rare moment of concurrence, the IPCC partially agreed with the previous assessment when they predicted “reduced winter mortality in mid- and high-latitudes” (IPCC WGII, 2001). In addition, other skeptics have determined that in a slightly warmer climate the health conditions of most Americans, Europeans, Japanese and people living at high latitudes would improve along with life expectancy (Moore 1998). The skeptics also argue that diseases such as Malaria, Yellow and Dengue Fever, and Cholera will not increase world-wide as a result of global warming but only as a result of increased poverty, crowding, and unsanitary conditions (Moore 1998; Michaels and Balling 2000). Finally, the skeptics and the IPCC are also in variance on the predicted rise in global sea levels. Michaels and Balling (2000) forecast an increase of from 5 to 11 inches by 2100. Moore (1998) predicts a sea level rise of about 18 inches by the 21st century. However, the IPCC predicts an increase in sea level from 3.5 inches to almost 35 inches (0.09 to 0.88m) by 2100 (IPCC WGII, 2001). Overall, the skeptics paint a much more rosy picture of what lies ahead for global society in the climatically changed world of the future. But why such a big diversity of findings?

The majorities of skeptics are employees of conservative US think tanks or are directly employed by fossil fuel intensive industries (McCrigh and Dunlap 2000). The conservative thinks tanks are considered by some to be “the most influential anti-environmental countermovement organizations at the national level” (McCrigh and Dunlap 2003). Also, studies have found conservatism is negatively related to pro-environmental attitudes and values in the general public, among political elites, and

especially among members of Congress (Dunlap, Xiao, and McCright 2001).

Moreover, conservatives often perceive the pursuit of environmental protection as a danger to economic libertarianism, industrial capitalism, prosperity, and American lifestyles and accordingly climate change policies are viewed as a growing threat to conservative beliefs and lifestyles (Bailey 1993; McCright and Dunlap 2003).

Consequently, the self-styled protectors of conservatism do not deem pro-climate change science to be convincing, they argue that climate change will mostly be benevolent, and that policies designed to lessen climate change impacts will do more harm than good (McCright and Dunlap 2003). On the other hand, most scholars have concluded that “a robust international consensus about the reality and seriousness of climate change has emerged as evidenced by the several comprehensive reports” from the National Academy of Science (NRC 2001), the IPCC (1990, 1995, 2001), and the World Climate Program (1985) (McCright and Dunlap 2003, 348).

Corporate Environmentalism and Global Climate Change – Summary

The Kyoto Protocol is the most intricate far-reaching environmental treaty that has ever been attempted. It impinges on nearly every industry, almost all forms of transportation, and most households and any future climate change agreements will have to be expansive, comprehensive, and yet flexible. A business as usual approach driven solely by economic growth priorities promoted by supporters of corporate environmentalism may be unable to develop the social, political, environmental and economic changes necessary to counter global climate change. In addition, business as usual policies could lead to doubling or tripling of greenhouse gas concentrations in the

atmosphere before the end of the 21st century with impending catastrophic implications (Houghton 1997; IPCC WGI, 2001; Schneider, Rosencranz, and Niles 2002).

Individual efforts by corporations around the world may not avert climate change because firms do not have common incentives to jointly reduce greenhouse gas emissions and in fact have overwhelmingly perverse incentives to increase emissions if their competitors take the high road and reduce emissions (Grieco 1988; Toman 2001; Goulder and Nadeau 2002; Wiener 2002). The conservative nature of the dominant social paradigm and especially corporate environmentalism encourage unlimited development of natural resources in order to retain the prosperous lifestyles found primarily in the modern industrialized nations. Corporate environmentalism is the paradigm for the wealthy, bent on the continued abolition of government regulations that impede profits and markets and the maintenance of their elite positions and sovereignty (McCright and Dunlap 2003).

On the other hand, a potentially effectual conservative approach to regulating emission reductions has gained the support of many economists and some climate scientists (Schelling 1997; Nordhaus 2001). Specifically, conservative modification to the Kyoto Protocol's aggressive emission reduction targets may be prudent, viable, and cost effective (Toman 2001).

Nevertheless, mitigation and adaptation efforts could on the whole require liberal, aggressive, and comprehensive policies that are compatible with both economic and ecological requirements. Corporate environmentalism essentially changes nothing, maintains business as usual, and expectantly looks to science and technology to divine a cost free escape from the dangers of global climate change. The policies based on this

rather exclusionary, elitist, and overly optimistic approach purposely overlook the needs of most of the planet's human and non-human populations. As a result, the dominant social paradigm and especially corporate environmentalism are in disequilibrium with anthropogenic and ecological systems and must be replaced by a new environmentally acceptable social paradigm if destructive climatic events are to be prevented. The new environmental paradigm calls for reformation or possibly radical transformation of the current relationships between nature and man and especially between the capitalist economic system and the not so elastic natural ecological systems. The question remains is how radical a reformation or transformation of the current global capitalist economic system is needed to counter the negative effects of global warming.

Ecological Modernization and Global Climate Change – Introduction

Ecological modernization emerged as a social theory in the early 1980's in Germany (Huber 1982; Janicke 1986). During this period scholars were concerned with the growing synergism between economic growth and increasing ecological degradation, especially in the environmentally advanced countries of Japan, the US, Sweden, Germany, the Netherlands, and Denmark. Also, circumstantial events (the Chernobyl accident, discovery of the ozone holes, and the emergence of evidence of global climate change) all collided to bring environmental issues to the public's attention (Toke 2001). As a result, researchers began looking for ways to decouple or de-link material, natural resource flows from economic flows in such a manner that could even result in an absolute decline in natural resource consumption and discharge of pollutants without a subsequent decrease in economic growth (Hawken, Lovins, and

Lovins 1999; Mol 2002). Ecological modernization theory proposes the restructuring of economic institutions and social practices by means of environmentally induced pressures from political, social, and environmental organizations resulting in the interdependence of ecological and economic viewpoints. In sum, economic processes of production and consumption are judged, analyzed, designed, and organized based on both ecological *and* economic priorities (Hawken, Lovins, and Lovins 1999; Mol 2002).

Agents

The primary agents of ecological modernization are economic actors, political and social institutions, and environmental movements. In particular the agents of ecological modernization strive to reform the institutions of modern society; the market, the state, and science and technology (Mol 2002). Reformation will be guided by the interaction of, on one hand, economic markets and actors, and on the other, organized citizen-consumers, environmental groups, and political institutions (Sonnenfeld and Mol 2002). From this group of reformers, four instrumental agents have been identified that also interact in climate change negotiations.

During international discussions of climate change, producers are key actors and most of the central producers are economic market agents. To date most of the focus of climate change debate has been on regulating the activities of the major anthropogenic producers of greenhouse gases; fossil fuel and biomass burning (IPCC WGI, 2001). Specifically, the focal points have been on energy production, transportation activities, industrial processes, land use processes, and residential/commercial activities, which generate almost 100% of the worldwide anthropogenic greenhouse gas emissions

(EDGAR 2000). Accordingly, climate change negotiations have concentrated on limiting the production of greenhouse gases by these agents in industrialized states using legally binding emission reduction targets (UNFCCC Kyoto Protocol 1997, Article 3). Subsequently, incorporated in the Kyoto Protocol are “producer mechanisms,” that include emission accounting (Article 7), life-cycle analysis (Article 2), and environmental management practices (Article 2) that embody instrumental ecological modernization concepts (Sonnenfeld and Mol 2002, 1326).

A second group of ecological modernization agents involved in climate change debates are the administrative actors (Sonnenfeld and Mol 2002). The chief administrative agents for climate change negotiations are state governments, the UNFCCC, and epistemic scientific and technological communities. Most industrialized state governments are obligated by the Kyoto Protocol to conduct annual audits to determine inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases. The Protocol requires these states to report the inventories to the UNFCCC administrative agents (UNFCCC Kyoto Protocol 1997, Article 7). Also, the CDM of the Protocol provides processes for states to generate CER credits that can be used to decrease legally binding emission commitments (Article 12). Subsequently, the Protocol provides for procedures for auditing and verification of the CERs (Article 12) and agents of the Kyoto Protocol administer each of these procedures.

Another group of ecological modernization agents, epistemic scientific and technological communities (Sonnenfeld and Mol 2002) such as the IPCC and the National Academy of Science, have contributed enormously to the creation and analysis of scientific, technical and socio-economic information relevant to comprehension of

climate change, its prospective impacts and options for adaptation and mitigation. The IPCC in particular is obligated to report its findings routinely to the Parties to the Protocol and the next full assessment report is scheduled to be completed in 2007.

The third aggregation of active ecological modernization and climate change actors are financial agents (Sonnenfeld and Mol 2002). In particular, the major financial agents involved in ecological modernization are economic actors, citizen-consumers, and political institutions. In relation to climate change the major financial actors are business/industrial actors, global consumers, and state governments affected by likely climate change policies. All three groups could be significantly affected by financial proposals to mitigate and adapt to global warming that include carbon taxes, emissions trading, subsidy reductions for greenhouse gas emitters, subsidy increases for carbon free activities, and technology/financial transfers (Petsonk, Dudek, and Goffman 1998; Greenwald, Roberts, and Reamer 2001). The most basic grouping of the financial proposals is into two general mechanisms: price based controls on greenhouse gases or quantity based control on greenhouse gases.

Price based mechanisms usually include carbon taxes or emission fees while the quantity based mechanism usually offer a permit or cap-and-trade system (Pizer 2001). Most economists support a price-based approach for controlling greenhouse gas emissions because it could generate as much as five times the expected benefit associated with even the most practical quantity control system. Additionally a price-based system can be levied upstream on fossil fuel producers or downstream on fossil fuel consumers, either way creates a fixed monetary incentive to reduce emissions (Pizer 2001).

The last influential assemblages of climate change agents are consumers.

Consumer choices are the driving force behind many decisions that producers and financial/administrative agents make. The ecological modernization processes that are needed to persuade consumers to choose climate friendly products and services are multifaceted. For instance, firms should convince consumers that higher fuel efficiency for automobiles and light trucks is good for the environment, economically effective, and would not negatively affect their lifestyles (Smith et al. 2002). Also, consumers must be made aware of the environmental and economic rewards from choosing energy efficient appliances, industrial equipment, electric generators or aircraft. Prospective and current home and building owners should realize the ecological and monetary benefits of energy efficient homes, offices, and commercial/industrial buildings (Hawken, Lovins, and Lovins 1999; Weyant 2000; Jaffe, Newell, and Stavins 2001). Consumers should also understand the climate friendly character of renewable energy sources when they look for new power sources or transportation vehicles (Hawken, Lovins, and Lovins 1999; Weyant 2000; Smith et al. 2002). The key to making consumers aware of the environmental and economic benefits of climate friendly products and services is the institutionalization of ecological modernization principles. Fundamentally, changing consumer choices is the key to changing the “relations of production” (Mol and Spaargaren 2000; Mol 2002).

Agents such as producers, administrators, financiers, and consumers form the core actors driving reformation of economic and ecological processes ingrained in the concept of ecological modernization. These reforms are critical processes to a socially, politically, economically, and environmentally acceptable solution to the climate

change challenge. New concepts such as eco-taxes, green GDP, environmental auditing and bookkeeping, annual environmental reports, environmental efficiency, environmental productivity, or environmental auditing are emerging globally (Mol and Spaargaren 2000; Mol 2002). Consequently, mitigation and adaptation demands principled eco-agents that ascribe ecological criteria to equivalent or higher priorities than economic criteria (Mol and Spaargaren 2000; Mol 2002) during the creation of a balanced, manageable, and enforceable climate change regime (Dannenmaier and Cohen 2000).

Emphasis

The goal of ecological modernization is an environmentally sound society that does not sacrifice environmental quality, quantity, and diversity for economic quality, quantity, and diversity. A central emphasis of ecological modernization is that the only way to ameliorate the growing ecological crisis caused by modern industrialization is by utilizing modern industrial science and technology (Blowers 1997; Mol 2002).

Subordinate to this main emphasis are three ecological modernization concepts that are also pertinent to the climate change discussions.

As stated before, ecological modernization emphatically stresses that ecological criteria must be institutionalized into modern production and consumption procedures (Mol 1996; Blowers 1997; Mol and Spaargaren 2000; Mol 2002). The main institutions in need of modification are modern science and technology and together they should be the main drivers in “ecologising the economy” (Mol 1996, 306). In relation, climate change mitigation and adaptation efforts could entail global changes to production and

consumption processes (Weyant 2000; Schneider, Rosencranz, and Niles 2002). The producers of greenhouse gases and the consumers of products and services that emit greenhouse gases have got to be managed, regulated, informed, and persuaded that dramatic climate change can only be averted by their cooperation, compliance, and consent (Dannenmaier and Cohen 2000; Mitchell 2001). Additionally, climate change policies that affect production may be impacted by substitution, innovation and cost uncertainty that subsequently dramatically impact consumer decisions and choices and vice versa (Weyant 2000). As a result, alterations in climate change related production and consumption patterns have to be analyzed for cost and environmental effectiveness and cost and environmental benefits (Weyant 2000). What's more, far-sighted application of new climate related scientific and technological discoveries can reduce the cost of climate change mitigations and most analysts conclude that development of climate friendly technologies should continue to improve in cost effectiveness and in market share (Edmonds, Roop, and Scott 2000).

Many researchers assert well designed economic and political policies can spur three types of technological change: invention, innovation, and diffusion (Edmonds, Roop, and Scott 2000; Weyant 2000; Berger 2002; Margolis and Kammen 2002). Investment into energy conservation and renewable energy sources, such as nuclear, solar, wind, biomass, hydro, and conservation could yield new greenhouse gas reducing inventions, innovation of existing conservation and renewable technologies, and rapid diffusion of these new technologies throughout the global economy, not just in industrialized countries, inducing a new international greenhouse emissions reduction technologies market.

Renewable and energy conservation technologies have recently reduced their power production costs and improved their overall reliability but still have been unable to significantly penetrate many global energy markets (see Table 5) (Darmstadter 2001; Berger 2002).

Table 5. Energy Sources – U.S. and the World in 1997 (Berger 2002)

Energy Source	United States %	World %
Oil	38	34
Coal	24	24
Natural Gas	25	20
Biomass fuels	3.8	13
Nuclear	7.7	6.4
Hydroelectric	1.3	2.3
Solar, wind, and geothermal	0.2	0.3

Also, in the last two decades, investment into energy technology research and development has declined significantly in industrialized countries even though studies indicate that research and development into energy technologies provide substantial returns on investment (Edmonds, Roop, and Scott 2000; Margolis and Kammen 2002).

What has slowed development of renewable energy and energy conservation technologies in the US in particular has been the dramatic decline in the cost of conventional energy generation due to the impacts of deregulation, technological improvements of fossil fuel generators, ongoing restructuring of the electric industry (Darmstadter 2001), and continued subsidization of the fossil fuel industry by the US government (Berger 2002). However, if climate change policies are implemented limiting fossil fuel use the attractiveness, viability, and market share of renewable and energy conservation technologies should dramatically improve (Edmonds, Roop, and

Scott 2000; Darmstadter 2001; Jaffe, Newell, and Stavins 2001). The process for rapid development of new renewable energy and energy conservation technologies requires two enabling agents.

The market is one of the prime enabling agents of ecological modernization (Blowers 1997; Mol and Spaargaren 2000; Mol 2002) and is also an enabling agent for climate change mitigation and adaptation (Petsonk, Dudek, and Goffman 1998; Toman 2001a, 2001b). As such, the market is the most effective way to “secure the flexibility, innovation, and responsiveness” needed to promote ecological modernization (Blowers 1997, 853) and climate change solutions (Petsonk, Dudek, and Goffman 1998; Toman 2001a, 2001b). Explicitly, market innovators, entrepreneurs, and economic agents are the driving forces behind ecological restructuring (Mol 1996). Climate change market innovators, entrepreneurs, and economic agents are also the driving forces behind developing new climate friendly technologies and are essential to development of integrated climate change solutions (DeCanio et al. 2000). The state is the other enabling agent for ecological modernization (Blowers 1997; Mol and Spaargaren 2000; Mol 2002) and climate change mitigation and adaptation.

Only the state can enforce a legitimate, comprehensive, and meaningful regulatory framework that allows the market to find the most cost-effective/efficient and eco-friendly solution to the climate change dilemma (Dannenmaier and Cohen 2000; Raustiala 2001; Russett and Oneal 2001). The role of the state would also change under ecological modernization from currently a curative and reactive approach to essentially a more proactive and preventive role, from an opaque policy-making process to a more transparent participative process, and from centralized control to more

decentralized execution (Mol 1996). States may have to intervene in the market with flexible, economically efficient, just, environmentally protective policies that spur technological innovations that also stimulate progressive environmental behavior (Mol 1996). Flexible, economically efficient, just, environmentally protective policies that spur technological innovations that also stimulate progressive environmental behavior are the objective of the Kyoto Protocol and in some respects the Protocol has succeeded in creating such policies (Petsonk, Dudek, and Goffman 1998; Wiegandt 2001). Yet, more work on the climate change regime remains to be done (Nordhaus 1992, 2001; Schelling 1997; Toman 2001a). The last emphasis is on two of the major actors involved in ecological modernization and climate change.

Transnational corporations are the precursors of the global economy and environmental movements are considered the source of global concern for environmental degradation (Blowers 1997). Together, they must collaborate on the climate change issue, combining and integrating economic and ecological perspectives, goals, and values into a balanced solution that incorporates both economic and ecological viewpoints (Raustiala 2001). These non-state climate change actors are viewed by some as augmenting state power by providing expert advice/information, helping set agendas, monitoring state activities, assisting in implementation, raising international awareness, and applying political pressure (Raustiala 2001).

In sum, the major emphasis of ecological modernization is the reconciliation of ecological and environmental perspectives. Science and technology could drive the ecologising of the economy and reduce climate change mitigation costs. Market based mechanism offer the best approach to balancing climate related ecological needs with

economic constraints. Finally, the state and non-state actors should have important roles to play in the implementation, verification, and enforcement of the climate change regime.

Central Concepts and Primary Outputs

The central premise of ecological modernization is the reconciliation of the economic and ecological spheres that result in a primary output of no decrease in economic growth accompanied by demonstrable improvements in environmental quality. In the past the ecological sphere has been subordinate to the economic sphere and supporters of ecological modernization propose the “emancipation” of ecology from the political and economic spheres (Mol 2002, 305). Also, proposed improvements in environmental quality were often couched in terms of jobs versus the environment rhetoric (Crowley 1999). Supporting the central concepts and primary output concepts are five major principles that facilitate emergence of ecological rationality parallel to economic rationality (Mol 2002). Each of these modernization principles has detailed and applicable characteristics to the climate change debate.

First, protection of the environment provides not only gains for the natural environment but also gains for the economy. The actions taken to care for ecological systems can create a win-win, positive sum outcome for all major actors (Toke 2001). Direct and ancillary benefits from mitigation and adaptation to global warming, although controversial and uncertain, have been tentatively calculated and measured. Direct benefits include prevention of damaging sea level rise, decreases in regional agricultural and forest productivity, increased extinction levels, loss of overall

biodiversity, and prevention of spread of vector-borne and water-borne diseases (Weyant 2000). The economic benefits from prevention or moderation of these direct effects range from \$5 to \$125 per ton of carbon emissions reduced (Weyant 2000; Burtraw and Toman 2001). Climate change policies that reduce greenhouse gas emissions may also create supplementary benefits through reduction of emissions of other air pollutants such as sulfur dioxide (acid rain precursors), oxides of nitrogen, volatile organic compounds (both precursor of smog), and lung damaging particulates (Weyant 2000). The economic benefits of auxiliary environmental effects range from \$7 to \$20 per ton of carbon (Weyant 2000; Burtraw and Toman 2001). Combining economic and ecological objectives should also provide further dividends.

Scholars have also established that the demand for high quality, high value products that meet stringent environmental standards should have enormous job creation possibilities that, as an added benefit, would reduce the economic weight of environmental protection (Crowley 1999). Climate change policies could compel the formation of “green jobs” creating, for example energy efficient appliances, cars, or aircraft or reforestation of tropical rain forests. As a result, the jobs versus environment impasse could also be reconciled. In sum, protection of the environment from climate change can in fact be a win-win proposition from both an economic and ecological point of view.

Second, economic growth and ecological protection are compatible and reciprocal requirements for future generations (Toke 2001). Innovation, research, and development are engines of economic growth and environmental protection. Innovation, research, and development are also necessary prerequisites for carbon-free

energy, transportation, industrial, and land use processes and technologies. More importantly, innovation, research, and development need economic growth for financial support.

Economic theories of endogenous technological change conclude that subsidies for climate-related research and development should overall lower the costs of emission reduction markets worldwide and lessen the overall load of climate change mitigation and adaptation on the global economy (DeCanio et al. 2000). Additionally, adjustment of production and consumption processes in a climate friendly direction depends on the deployment of new and cleaner energy delivery technologies (Weyant 2000).

Distinctively, production and consumption functions must transition to fuels and technologies that are decarbonized (Margolis and Kammen 2002). As a result, many new studies of the economic and environmental impacts of global warming find that a strong, flexible, international regime that utilizes gradual but accelerating greenhouse gas abatement trajectories (Toman 2001a, 2001b), subsidies for climate-related research and development (DeCanio et al. 2000), economic and regulatory compliance and enforcement mechanisms (Dannenmaier and Cohen 2000), and a regime that applies market-based mechanisms (Petsonk, Dudek, and Goffman 1998; Weyant 2000) balanced against ecological criteria (Mol 1996; Blowers 1997; Mol and Spaargaren 2000; Mol 2002) would be compatible with economic growth and would accomplish mitigation and adaptation goals.

Third, ecological modernization activists recognize that most environmental problems are complex, have interrelated contingencies, and often require integrated solutions (Toke 2001). As a global environmental problem, climate change runs the

gamut of political, social, economic, and environmental challenges. Politically, climate change has drawn the two prevailing international relations worldviews, realism and liberalism, into direct conflict (Matthew 1999). Socially, climate change challenges the major theories of social environmental change; the dominant social paradigm (corporate environmentalism) and the new environmental paradigms (ecological modernization and radical environmentalism) (Gibbs 2003). Economically, climate change discussions bring into play North – South disputes and significant consideration of equity and income inequality (Claussen and McNeilly 2000; Cazorla and Toman 2001; Agarwal 2002; Baer 2002; Aldy et al. 2003). Environmentally, climate change has diverse and multifaceted global implications (See Table 1, IPCC WGII, 2001; NRC 2001). The recognition of the interrelationship between political, social, economic, and environmental spheres by ecological modernization theorists as a major focal point of the concept offers enormous insight into comprehending and solving climate change issues.

Fourth, at times, government intervention into the free market may be required in order to resolve economic and environmental conflicts. Intervention could include pollution taxes, environmental standards, emission trading schemes, voluntary agreements, or even economic penalties for violations of environmental/economic standards (Toke 2001). Specific to the climate change regime are economic approaches that employ subsidies, incentives and permits to softly compel producers, administrators, financiers, and consumers into compliance with regime mandates. On the other hand a harder, regulatory approach can be utilized based on carbon taxes, outcome-based standards, and process/technology based standards applying corrective

or punitive techniques to implement climate change policies (Dannenmaier and Cohen 2000). The final principle involves economic competitiveness.

Ecological modernization theory proposes that the companies that are able to manufacture products according to the highest environmental standards should be able to win the largest market shares, penetrate the most markets, and become market leaders (Toke 2001). Environmentally safe, high quality, high value products should be the most competitive products of the new post industrial, ecologically modernized economy (Mol 1996; Crowley 1999; Mol and Spaargaren 2000; Mol 2002). For example, numerous studies have found that many firms are not optimizing their economic and environmental protection performance. These companies have not utilized the full range of options (organizational, contractual, technological, etc.) available to reduce pollutants (such as greenhouse gases) with no decline in production and profitability (Hawken, Lovins, and Lovins 1999; DeCanio et al. 2000).

Researchers concerned with the economic impacts of global warming assert that a push is needed toward an integrated approach to achieving environmental and economic goals that would improve both economic and environmental protection performance. Corporate objectives such as financial performance, productivity, market share, customer satisfaction, or employee motivations can be modified to support and incorporate environmental objectives like pollution prevention (greenhouse gases), waste reduction (emission leakage), and a positive public image (climate friendly products and services) (Hawken, Lovins, and Lovins 1999; DeCanio et al. 2000). Innately, an integrated approach is directly germane to climate change issues as a means

to reduce greenhouse gas emissions without negatively affecting the economic competitiveness of firms or states.

Typical Forecasts

Supporters of ecological modernizations foresee real, substantial, but perhaps non-linear improvements in the global environment. Ecological modernization advocates also anticipate emergence of new social, political, and economic models that will broaden the foundation and applicability of ecological modernization theory. Concepts like environmental auditing, bookkeeping, efficiency, productivity, and a measure for ecological gross national product are being developed and expanded (Mol and Spaargaren 2000). In a more direct sense, ecological modernization predicts a future where increased economic production and consumption does not unambiguously cause increased environmental degradation and destruction. Ecological modernization initiatives would then foreshadow a climate change regime that encourages and permits economic expansion in a responsible climate related and environmental mode. Carbon-free energy, transportation, land use, and industrial processes would dominate the economic sector and would all operate under stringent environmental standards, and productivity and profitability would not suffer as a result. Optimistically, climate change mitigation, adaptation, and global environmental protection would be reconciled with continued growth of the global economy. The definitive forecast would be for international media, global environmental groups, international political institutions/actors, and state governments “to intervene in global markets and condition the actions of global producers” toward climate friendly outcomes (Mol 2002, 105).

Ecological Modernization and Global Climate Change – Summary

Ecological modernization theory ideally offers a very strong prescription for the social, political, economic, and environmental changes required to battle global climate change. The theory focuses on science and technology as the central institutions that must be reformed in order to institutionalize joint ecological and economic principles and perspectives and this focus answers the call for solutions to many dilemmas created by global warming (Mol 1996). As such, science and technology are expected to be the motivating forces behind mitigation and adaptation efforts (DeCanio et al. 2000; Edmonds, Roop, and Scott 2000; Smith et al. 2002; Aldy et al. 2003). Additionally, the central role played by markets and market mechanisms as core ecological modernization suppositions (Blowers 1997; Mol and Spaargaren 2000; Mol 2002) provides a clear opportunity for economists also interested in tackling climate change issues (Petsonk, Dudek, and Goffman 1998; Toman 2001a, 2001b).

Ecological modernization scholars also do not discredit the power of the state and welcome the expertise, flexibility, and skills of many non-state actors to the process of resolving the once antagonistic relationship between nature and the market (Blowers 1997; Mol and Spaargaren 2000; Mol 2002). In the same way, climate change researchers look to the state and non-state actors for a multiplier effect in the struggle to effectively and efficiently counter the overwhelming challenge of global warming (Dannenmaier and Cohen 2000; Raustiala 2001; Russett and Oneal 2001). Ecological modernization activists point to the ever increasing number of successful environmental reforms resulting from the interaction between economic agents/markets and coherent

citizen consumer groups that are coupled with strong political institutions (Mol 2002). The reforms advocated by supporters of ecological modernization appear to be the right medicine to cure some ills resulting from global climate change, but are the reforms radical enough to stop an international virus of the likes of the anthropogenically enhanced greenhouse effect? Hopefully, “political decisions, civil pressure, and citizen-consumer demand” can be decisive (Mol 1996).

Radical Environmentalism and Global Climate Change – Introduction

The third social environmental paradigm to be analyzed, radical environmentalism is also a derivative of the new environmental paradigm. Advocates of radical environmentalism declare global capitalism is the “root cause” of continuing “social and environmental destruction” (Mol 2002, 95). Capitalism, it is asserted, is responsible for the present ecological and social predicament and the only way out of the quandary is to eliminate capitalism (Pepper 1984; O’Connor 1991, 1996). Also, radical environmentalists contend that the global capitalist economic system will destroy itself because capitalism’s endless focus on production and consumption threatens the very sustenance base that production and consumption forces rely upon (Pellow, Schnaiberg, Weinberg 2000; O’Connor 1991, 1996, 1998; Mol 2002). Two key neo-Marxist perspectives that identify and analyze the social, political, economic, and environmental threats of global capitalism form the basis of radical environmentalism; the treadmill-of-production concept and the second contradiction of capitalism theory.

The treadmill-of-production concept focuses on the efforts “by market actors to extract natural resources and to convert them into profits through market exchanges” (Pellow, Schnaiberg, Weinberg 2000, 132). According to the model profits are subsequently reinvested back into the firm and used to purchase new, technologically advanced, consistent, and efficient physical capital. The new technology reduces labor costs, increases production capacity, and eventually replaces expensive and unpredictable workers. Profits are continually used to purchase new, productive physical capital and are seldom reinvested in improving labor conditions, enhancing environmental protection, or increasing worker social security. As a result, employment capacity decreases and the flow and quantities of natural resources for the new high-cost, efficient technologies remains constant or increases. The profits of economic organizations through market exchanges and/or levels of share prices/dividends of public investors exert treadmill forces. The agents controlling the exchange values come to dominate the community actors with use-values. Eventually, market exchanges come to control all aspects of community life, even those not previously related to market activity, like clean air, water, and land needs. These environmental goods are reduced to simple commodities that are subject to the inconsistencies of the market for valuation (Pellow, Schnaiberg, and Weinberg 2000). At the end of the day, treadmill production and consumption reasoning will always be the supreme influence on economic activities at the expense of sustainable production and consumption standards (Mol 2002). The next neo-Marxist concept, the second contradiction of capitalism fills out the radical environmentalism paradigm.

The first contradiction of capitalism concerns the unequal distribution of surplus value that leads to uneven development, unemployment, over production, under consumption, inequality, exploitation, and ultimately to class warfare and revolution (O'Connor 1991, 1996; Pease 2000). The second contradiction of capitalism theory proposes that "the economic growth and expansion that are inherent within the global capitalist economy will run up against environmental boundaries that will, in the end, turn the tide of the global capitalist economic order and change it beyond recognition" (Mol 2002, 95). Supporters of the second contradiction argument assert that the current ecological crises will create a barrier to capital accumulation that will endanger the growth of global capitalism and eventually leads to capitalism's downfall (O'Connor 1991, 1996; Spence 2000).

In addition, the second contradiction of capitalism does not manifest itself in a tendency for overproduction (a central point of the first contradiction of capitalism identified by O'Connor (1996)) but in a predisposition to under produce that will in the end be magnified by a crisis of liquidity or capital shortages as economies hit environmental barriers (O'Connor 1991, 1996; Spence 2000). Eventually the second contradiction will compel creation of new social movements that become the primary mediators of progressive social change (O'Connor 1991, 1996; Spence 2000).

Both neo-Marxist perspectives contend that in the capitalist economy people only relate to one another through money, commodities, and the market. Natural limits on production and consumption cease to exist in capitalist society's collective identity and unconstrained pursuit of capital accumulation. Nature only becomes pertinent when it imposes additional costs on capital accumulation or disrupts human life (Gibbs

2003). Unexpectedly, radical environmentalism has interesting and forthright implications for climate change issues and solutions.

Agents

Classes, the state, and environmental movements are the primary agents of radical environmentalism. The struggle by worker classes around the world to prevent global environmental degradation by profit seeking capitalists is manifested in many examples: rich versus poor, developed countries versus less developed countries, or the North versus the South. The state (primarily modern industrialized states) is viewed by radical environmentalists as the protector of the bourgeoisie capitalist economic system and as the main antagonist of proletariats worldwide (Pease 2000). Environmental movements are seen as the key agency for social change in response to global environmental ruin similar to the position played by proletariat social movements (O'Connor 1991, 1996). Economic classes, the state, and environmental movements are heavily caught up in global climate change negotiations.

Economic classes and states are the primary competitors implicated in creating a climate change regime. The primary economic classes concerned are the proletariat or worker class and the bourgeoisie class, industry owners and the controllers of capital and markets (Pease 2000). Two of the most well known Marxist theories that analyze the role of the state are dependency theory and world system theory. For dependency Marxists there are two primary alignments of states; developed and underdeveloped (Dependency studies include but are not limited to: Dos Santos 1970; Amin 1977; Valenzuela and Valenzuela 1978; Cardoso and Faletto 1979; Packenham 1992). For

world system Marxists there are three primary grouping of states; core states (developed), semi-periphery states (semi-developed), and the periphery states (undeveloped) (Wallerstein 1974).

Regardless of the assemblages the main culprits in climate change discussions are the wealthy, mostly Northern, modern industrialized states (Agarwal 2002) and as such radical environmentalists view the wealthy states as simply “a reflection of the dominant class interests, the domestic bourgeoisie” (Pease 2000, 77). Further, developed states consider developing states as chiefly a source of inexpensive, unskilled labor, and raw materials. Still, many radical environmentalists argue industrialized states created the climate change impasse and consequently should lead efforts to remedy global warming evils (Agarwal 2002).

Many researchers consider global warming the direct result of “the North’s industrialization process and the US’s love affair with the automobile” (Pease 2000, 195). As evidence, the 25% percent of the world’s population living in the industrialized states account for over 55% of the greenhouse gas emissions (Pease 2000). Also, radical environmentalists assert biased science from the North and hegemonic veto activities by powerful capitalist states (especially the US) have produced a weakened, flawed, and inequitable international climate change regime (Pease 2000; Rowlands 2001; Agarwal 2002). The Kyoto Protocol essentially is a “victory for capitalism and international industries because it accomplishes very little, which is precisely what industry wants” (Pease 2000, 202). Radical environmentalists contend industrialized countries must repay the ecological debt they have incurred while creating the luxurious lifestyles they enjoy and not unfairly force developing

states to restrict their growth through inequitable accords such as the Protocol. Additionally, radical environmentalists argue international organizations, such as the IMF, World Bank, UNFCCC, and the IPCC are employed by the dominant capitalist states to “facilitate and manage industrial change by conditioning the impact of states on changing markets and vice versa” (Pease 2000). Even many non-state actors like NGOs (for example the Global Climate Coalition) are instruments of capitalist domination and are used to legitimize the current underlying economic system (Pease 2000). As a result, many activities of the governing bourgeoisie of the industrialized states oppress and exploit the global working classes.

The power of working classes is further weakened by capitalist exploitation when states attempt to solve environmental problems using private property rights (Pease 2000). Managing the global atmosphere by means of greenhouse gas emission rights trading (i.e. a form of private property) will further destabilize the environment by embedding the caustic capitalist economic system deeper into climate change mitigation and adaptation policies and plans. Additionally, if the bourgeoisie, already central in capital generation and the market, are allowed to control distribution of emission rights, the current inequitable social and economic system will be perpetuated and emission rights will only be viewed as a means to surplus values or profits and consequently will not be administered according to ecological viewpoints or requirements (Spence 2000). In response, radical environmentalists have accorded a special position for environmental movements in the struggle against the evils of global capitalism.

Radical environmentalists consider climate change negotiations a reflection of the international conflict between developed and developing states and the global conflict between the proletariat and the bourgeoisie. As such, radical environmentalists confer upon environmental movements the prestige, function, and importance of the proletariat (O'Connor 1991, 1996; Spence 2000). Global environmental movements represent and lead the "rebellion by nature" that ultimately will end the exploitation of natural ecosystems (O'Connor 1996, 212), while simultaneously the working class will lead the fight against capitalism and eventually build a new socialist global society (O'Connor 1998).

Environmental movements concerned with global warming are also seen as leaders in the battle against the exploitation of nature and are considered a significant influence on international climate change politics. Purposely, environmental movements seek greater cuts in greenhouse gas emissions than those promoted by the Kyoto Protocol and also strive to include in negotiations global equity, poverty, and development concerns (Raustiala 2001; Agarwal 2002). In sum, the debate is a continuation of the struggle between the proletariat and the bourgeoisie and the only obstacles to capitalism's absolute victory are efforts by the working classes, global environmental movements, and the natural barrier to capitalism, ecological development limits.

Emphasis, Central Concepts, and Primary Outputs

The advocates of radical environmentalism criticize the logic of the capitalist economic system. Capitalists argue environmental degradation is an inevitable,

necessary, and benign by-product of capitalist production and consumption. As a result, radical environmentalists complain that nature must be endlessly despoiled to maintain economic growth and the dominant position of capitalists (Gibbs 2003). Accordingly, supporters of radical environmentalism concentrate on social transformation of the capitalist/treadmill features of production and consumption (Mol 2002). Social transformation entails creation of a more egalitarian society by changing the focus of the existing capitalist economic system that concentrates on profits and market share and subsequently exploits labor to a more benevolent socialist economic system that provides for the social welfare of all citizens in a classless society. Climate change researchers have also found value in radical transformation of the capitalist economic system.

Capitalist economists have offered a popular solution to the climate change problem. The economists sponsor formation of a market trading in emission permits (Petsonk, Dudek, and Goffman 1998; Fischer, Kerr, and Toman 2001; Toman 2001a; Smith et al. 2002). The new commodity to be traded is the “right to pollute” and would be based on the “magic of markets” (Spence 2000, 101). The plan is to use a limited market to address a global environmental problem by essentially placing a price on nature.

Oil and gas are removed by firms from beneath the earth, transported to markets by pipe-lines and tankers, sold to refineries and industries, converted into fuels and products and consumed by power plants, cars, in homes, and in workplaces. The greenhouse gas emissions causing global climate change result from millions of these different commodity relationships, a diverse process of exchange-value transactions that

are at every step under constant demand from market pressures to generate profits, accumulate capital, and to increase market share. In very few instances are there market pressures for environmental protection or specifically for climate change mitigation or adaptation and this multiplies the amplitude and gravity of the current global environmental crisis (Spence 2000). As a result, the Kyoto Protocol provides the guidelines for just another market selling just another environmentally unregulated commodity. Radical environmentalists submit that the only recourse to the capitalist exploitation machine is transformation of global social and economic systems.

Radical environmentalism defenders stress that absolute sustainability is the only alternative if global society is to survive and overcome the treadmill of production and the second contradiction of capitalism. Social and economic transformation could involve establishment of an egalitarian socialist society that incorporates ecological limits and perspectives into plans, policies, and solutions. The endeavor to transform society would engage all mankind and would also seek to dramatically transform global values. The “new” values would bring back nature into the lives of many, curb the drive for material wealth, better the lives of the Third World’s poor, bring freedom and equal rights to women, and liberate all people from basic material want (Pepper 1985).

Radical environmentalists do not regard capitalism as pre-ordained and would eliminate the exploitative and destructive elements of the capitalist economic system and replace them with a balanced and mutually reciprocal human-to-nature relationship (Pepper 1985). The radical transformation should not only transform values and ideas but also radically change the means of production. Capitalist means of production must be replaced by socialist principles that include wealth redistribution and respect for

ecological limits. The ultimate goal, absolute sustainability where the needs of the current generation do not jeopardize the needs of future generations, can only be attained after the capitalist economic system is removed. Absolute sustainability is measured by the eco-efficiency of the economy in relation to economic efficiency and is directly applicable to the climate change debate.

Most climate change economists currently only evaluate emission taxes or tradable emission permits or a combination of the two in relation to the maximization of profits, a typical capitalist economic calculation. Often overlooked are eco-efficiency factors such as “communal” environmental quality goals or conforming business objectives to the values and motivations of employees (DeCanio et al. 2000). The conventional capitalist approach constantly pits environmental objectives against corporate objectives and the unfailing loser may become global climate stability. Therefore, only radical transformation of the conventional approach into an integrated approach that incorporates socialist values and ecological principles could enable formation of a sustainable international economy and ensure global climate change mitigation and adaptation.

Typical Forecasts

Radical environmentalists stress that continued exploitation of nature by the capitalist economic system makes any consequential and lasting improvements in global environmental quality unattainable. Supporters of radical environmentalism often deride ecological modernization advocates for fashioning only “window dressing” environmental changes and for their failure to get at the “roots of the environmental

crisis,” global capitalism (Mol 2002, 96). In addition critics of industrialized states argue that the current climate change regime will only globally entrench the carbon-intensive energy infrastructure and perpetuate inequality between the developed states and the undeveloped states (Agarwal 2002). Specifically, the highly utopian characteristics of radical environmentalism’s forecasts are based on radical transformation of existing social patterns in response to the threats of “high consequence risks” like climate change, large-scale nuclear accidents, or nuclear war (Mol 2002, 98). Supporters contend that these “high consequence risks” for the first time threaten the ability of natural global ecosystems to adapt to the rapid changes these risks would induce and could inexorably threaten human survival (Blowers 1997).

Climate change researchers in particular have found evidence of climate induced “high damage” scenarios (DeCanio et al. 2000). However, current capitalist economic models of the impacts of global warming (Nordhaus 1992; Fischer, Kerr, and Toman 2001; Toman 2001a) do not adequately account for these risks as they undervalue the threats of possibly catastrophic climatic incidents (Woodward and Bishop 1997; Schneider and Kuntz-Duriseti 2002).

The risks not accounted for are from non-linear responses of the climate system in which a given incremental force yields a disproportionate reaction and in essence, once a presently unknown equilibrium point is exceeded then the system rapidly switches-over, perhaps catastrophically, to a new equilibrium point. Switchover scenarios have been investigated and scientists have warned global society of unforeseen devastating climatically induced flip-flops; disruption of indispensable global oceanic currents or rapid deglaciation of polar ice caps (Houghton 1997;

DeCanio et al. 2000; IPCC WGI, 2001; Schneider and Kuntz-Duriseti 2002). These calamities could be caused by non-linear responses to smooth forcings on the climate system induced by existing linear increases in greenhouse gases concentrations (DeCanio et al. 2000). The contemporary treadmill of production and consumption by capitalist economies almost assures that concentrations of greenhouse gases will increase for at least the next decade unless radical change occurs or a natural barrier to capitalism is encountered.

Radical environmentalists view high-risk events as one of the natural barriers that global capitalism will eventually confront and that will ultimately lead to capitalism's collapse (O'Connor 1996). Also, as the capitalist world has rushed to adopt new technologies, the risks these new, often inadequately tested products of modern science pose are unaccounted for, dispersed throughout society, and eventually could threaten human survival (Beck 1995; Blowers 1997; Steel, Clinton, and Lovrich 2003). The only sensible response to the threat to human survival posed by widespread global warming is fundamental change in social institutions, values, and lifestyles (Pepper 1985; Blowers 1997).

However, Northern advanced industrial states have used and continue to use their diplomatic and political powers to skew the climate change debate (Blowers 1997; Agarwal 2002). The capitalist North continues to depict climate change as an economic hazard not as a threat to survival. Some researchers challenge we have reached a developmental phase of society where the social, political, environmental, and individual risks produced by the varied powers of modernization are increasingly uncontrolled by the purported protective institutions and organizations within society

(Beck 1996; Lash, Szerszynski, and Wynne 1996). The politics of liberal, democratic capitalist societies are to blame for global climate change risks but the capitalist institutions are inadequate to control or protect society and thus have become inappropriate to counter the coming social, political, economic, and environmental crisis (O'Connor 1991, 1996; Blowers 1997; Spence 2000). As a result, radical social, political, economic, and environmental transformation is the only logical option.

Radical Environmentalism and Global Climate Change – Summary

Radical environmentalism is an extreme offshoot of the new environmental paradigm. It is a neo-Marxist paradigm that emphasizes the continuing struggles between the oppressed working classes and the dominant capitalist bourgeoisie. Radical environmentalists see confirmation of this struggle in global climate change negotiations, debates, and discussions. Accordingly, the poor, exploited workers of the world would probably suffer the most from harmful climate change events while the bourgeoisie use the state apparatus to protect themselves and their privileged positions unless something radical transpires.

The treadmill of production and consumption enforced by global capitalism exploits labor and under-employs workers, at the same time perpetuating environmental degradation in the name of economic growth and increased profits. However, the treadmill may run into a natural barrier to further capital accumulation by the bourgeoisie in the form of global climate change. Unless radical transformations of the social, political, economic, and environmental configuration of the global capitalist system are not initiated, the very survival of humanity may be in jeopardy. Extreme

climatically induced flip-flops in key natural ecosystem processes could threaten both humanity and nature. The route to absolute sustainability and away from global catastrophe must be down the path of radical environmentalism. The journey includes a all-encompassing transformation of the asymmetrical capitalist society into a classless socialist society that recognizes the requirement of all citizens for equal freedom from material want. The journey also includes establishment of a nature-based social order that maintains the sustenance foundation for current and future generations. This is the path promoted by radical environmentalists responding to the ominous threats posed by global climate change.

Social and Ecological Disequilibrium – Conclusions

The untenable relationship between human social systems and natural ecological systems is threatened by global climate change. A dramatic paradigm shift from the dominant social environmental paradigm, corporate environmentalism, to a new environmental social paradigm could occur this century. The challengers to the dominant social paradigm, ecological modernization and radical environmentalism each offer substantially different options for change and solutions to the dispute.

Corporate environmentalism is the path that brought us to the current predicament. Supporters of corporate environmentalism are too narrowly focused on deregulation of the firm, nonintervention by government, and corporate success. Maintenance of the status quo, as advocated by corporate environmentalists, is not viable. Continued business as usual production of greenhouse gases is unsustainable and environmentally devastating. A conservative approach to climate change

mitigation and adaptation that does not recognize the interdependence of economics and ecosystems would only continue global environmental degradation indefinitely and prevent application of cost effective and eco-efficient climate change solutions.

Climate change is not benign and could be life threatening if the focal point of the global economic system is exclusively on profits and market shares. Corporate environmentalism is the problem not the solution, but is ecological modernization any better?

Ecological modernization theory expands the argument about environmental change to include economics, politics, and societal concerns. Promoters of ecological modernization recognize that corporate environmentalism must be reformed if climate change is to be mitigated or adapted to. The very institutions that are responsible for global environmental degradation must be reconciled with environmental protection institutions and the needs of both incorporated and balanced. Technology and science must be utilized as tools to restructure industrial and business processes so that ecological viewpoints receive equal precedence with profit margin and market share considerations. Economic growth and technological innovation must become the engines of climate change mitigation and adaptation. Greenhouse gas emissions have to be reduced, new energy sources developed, new transportation options created, and climate friendly land use choices enhanced, expanded, and implemented. Real changes have to be made to global political, social, and economic institutions that embed ecological modernization principles from top to bottom and from bottom to top and only if substantial, pervasive, and effective changes are made can climate change be

positively addressed. Ecological modernization cannot be more of the same, green in color, but only on the surface. Otherwise, something radical may happen.

Radical environmentalism bravely attempts to fix not only the environmental crisis but many other global social ills as well. The battle between the proletariat and the bourgeoisie, between rich and poor, between developed states and undeveloped states, and the battle between the North and the South continues, but with an environmental twist. If global capitalism continues on the treadmill of production and consumption path greedy capitalists will probably run headlong into a natural barrier to further economic growth and capitalist expansion called global warming. The barrier will inflame and incite the workers of the world and the protectors of nature, global environmental movements. Together, the oppressed will overcome the capitalist elites and radically transform the dying capitalist system into an egalitarian socialist society, through wealth redistribution and establishment of new human-to-nature values and ideas that balance the requirements of humans with the needs of nature. If radical transformation of global social, political, economic, and environmental institutions and processes does not occur soon, cataclysmic climate change induced events may either hasten the change or portend the doom of all mankind. But which paradigm will prevail?

The middle path, ecological modernization, offers the best chance for successfully countering the challenge of global climate change. Studies of ecological modernization's market-ecological based approaches offer broad empirical evidence of successful application of ecological modernization principles (Crowley 1999; Mol and Sonnenfeld 2000; Spaargaren, Mol, and Buttel 2000; Roberts and Colwell 2001; Toke

2002) and market-ecologically based climate change studies have come to similar conclusions (Petsonk, Dudek, and Goffman 1998; DeCanio et al. 2000; Edmonds, Roop, and Scott 2000; Weyant 2000; Jaffe, Newell, and Stavins 2001; Toman 2001; Berger 2002; Margolis and Kammen 2002; Schneider, Rosencranz, and Niles 2002). Additionally, a pragmatic and optimistic approach to environmental change and especially to climate change is more likely to receive global public support than a radical approach that attempts to dismember the current capitalist economic system (Curran 2001). Business as usual got the world's climate into this predicament but harnessing the global power of the market to the inventive and imaginative powers of science and technology with the single minded purpose of solving the enormously challenging problems of global climate change could institutionalize environmental principles deeper into the heart of economic processes. Change from within should be stronger than radical change from without. Consequently, economic growth and ecological perspectives must be reconciled using the existing system, short of revolution, if climate change is to be remedied. In the end, the primary purpose of ecological modernization is "neither to overthrow nor to kneel at the altar of the market. The aim is to harness market forces by a practical governance that delivers both economic prosperity and social justice" (Curran 2001, 44).

CHAPTER V

DISEQUILIBRIUM BETWEEN RICH AND POOR

Introduction

“Global warming is all about inequality, both who will suffer most its effects, and in who created the problem in the first place” (Roberts 2001, 501). This statement implicates the rich, creators of global warming with the poor, suffers of climate change’s wrath. The inference then can be expanded to argue that the effects of mitigating or adapting to global climate change could radically impact the disequilibrium between rich and poor. Responding to global climate change may widen the gap between rich and poor or it may prove an opportunity to close the gap. That economic juxtaposition, among many others, will be explored in this chapter.

Many researchers question whether the combination of technology, regulation, and market mechanisms will be sufficient to solve growing environmental problems, such as climate change. Market forces are acknowledged as powerful influences on social and political activities (Gilpin 1987) and are equally powerful influences on ecological processes (Costanza et al. 1997). In the past economists mainly interacted with ecologists when data was needed over environmental and resource issues. Today, economists and ecologists work together to solve daunting environmental problems yet two opposing economic camps have developed. In particular, conventional, neo-classical economics are being challenged by an upcoming unconventional approach, ecological economics.

Neo-classical economists focus on market activities. Concepts such as individual utility, diminishing marginal utility, market equilibrium, and profit maximization are central features of neo-classical economics. Consequently, neo-classical economics tends toward a monistic perspective that excludes other social science viewpoints while relying heavily on physics and other natural sciences for support of major propositions and assumptions. Finally, neo-classical methodology and foundational concepts differ substantially from the ecological economic approach (Soderbaum 2000).

Ecological economics focuses on the nexus between ecological processes and economic activities. Major ecological economic propositions include systems analysis, fair distribution, efficient allocation, and sustainable development. Essentially, ecological economics is a multidisciplinary attempt to reintegrate ecology and economics into a process that effectively and efficiently tackles the problems created by finite resource and ecological constraints (Costanza et al. 1997).

Many of the core assumptions of neo-classical and ecological economics are key artifacts of general economic theory. As noted before, the core assumptions are the results of many years of refinement of a theory's fundamental nature using historical facts, empirical evidence, and steady reformulations that eventually result in the borders of a scientific discipline (Kuhn 1962). Again, the core assumptions of a paradigm produce an inherent nucleus of interdependent theoretical and methodological ideas that enable collection, appraisal, and analysis (Kuhn 1962). Below is a table identifying the core characteristics of two major economic worldviews:

Table 6. Core Assumptions of Neo-Classical and Ecological Economics (Modified from Soderbaum 2000)

Characteristics	Neo-Classical Economics	Ecological Economics
Agents	Firms, Individuals	Stakeholders (States, Businesses, Individuals, Scientists, Ecosystems, Plants, Animals etc.)
Central Concepts	Liberalism, Technological Optimism, Economic Growth	Liberal and Neo-Marxist Blend, Technological Skepticism, Sustainable Development
Processes	Mechanistic, Disseminate Knowledge, Market Driven, Reductionistic, Mathematical, Unidirectional Causation	Evolutionary, Interaction, dialogue, learning, Democratic, Holistic, Quantitative and Qualitative, Multi-directional Causation
Emphasis	Value Neutrality, Objectivity	Value Biased, Subjectivity (Interpretative)

The economic core assumptions identified in Table 6 will be used as the basis to determine which assumptions of the predominant economic concepts are most applicable to the climate change debate. Each proposition will be compared independently to determine how it may be applied to climate change impacts, issues, and potential policy responses.

International responses to global climate change could rock the core assumptions of these two economic paradigms and initiate a restructuring, a modernization, and a reconsideration of economic worldviews. The theoretical propositions that will expressly be investigated are:

1. The neo-classical economic paradigm is more applicable to global climate change discussions, responses, and solutions than the ecological economic paradigm.
2. The ecological economic paradigm is more applicable to global climate change discussions, responses, and solutions than the neo-classical economic paradigm.

Overall, the worldview that is most theoretically valid and reliable in reference to the global climate change debate may ultimately dominate economics research on this subject. In repetition, when the existing rules of the dominant paradigm cease to answer the puzzles that emerge, when there are observed discrepancies between theory and fact, a crisis occurs in the scientific community (Kuhn 1962, 68-69) and a paradigm change will come about.

Neo-Classical Economics and Global Climate Change – Introduction

Economics, in general, is the study of the production, distribution, and consumption of goods and services within markets. Economics, as defined by neo-classical economists, is the study of the allocation of scarce resources among alternative ends (Wikipedia 2004). The neo-classical approach is purported to have evolved from classical economics in the 1870s when economists began defining and refining market processes in mathematical terms (Soderbaum 2000). Economic markets and economies have several distinguishing characteristics.

A market economy has three important characteristics: prices, competition, and efficiency. Prices determine the dynamics of goods and services exchanges. Competition often determines individual and organizational behavior. Efficiency regulates which actors survive and which do not (Gilpin 1987). In a perfectly functioning market all actors have complete access to information about the goods and

services they seek or provide. Individual actors are assumed to be rational and have consistent utilitarian preferences for commodities that they consume (Soderbaum 2000; Muller 2001). At the base level individuals are assumed to interact through voluntary exchanges in the market place guided by an “invisible hand” that optimizes exchange transactions and resource allocations (Smith 1937).

The study of neo-classical economics has also been extended to cover environmental problems. When neo-classical environmental economists spotlighted markets it revealed a connection between competitive firms, environmental problems, and market failures. Market failures occur when the market fails to perform as expected. For example, if a property owner allows raw sewage from a pig farm to enter onto their neighbor’s property, the sewage creates a negative impact on the neighbor’s property and its value that is external to the usual internal market relationships. Market failures also occur when certain common goods and services (oceanic fish stocks, tropical rainforests, or the global atmosphere) cannot be or have not been individually appropriated or valued. Additionally, neo-classical environmental economists have endeavored to incorporate public goods concerns and free-rider problems into strategic economic behavior theories. Finally, neo-classical environmental economists recognize the necessity to moderate individual preferences through various techniques and even government interventions (Muller 2001).

In response, neo-classical economists attempt to address these external property rights and transaction cost issues via artful cost-benefit analysis of ecosystem goods and services and astute application of the Pigovian “government-assisted invisible hand” (Pigou 1920; Muller 2001, 419). Neo-classical economists have also accepted the

challenge of global climate change and a breakdown of the major assumptions of these economists will reveal the applicability, validity, and veracity of their theoretical responses to the global warming dilemma.

Agents

The major actors in neo-classical economic theories are individuals in households and business firms (Soderbaum 2000). The national economy is also essentially made up of firms and individuals. Firms produce and sell goods and services to individuals and attempt to set a level of production that will maximize profits. Goods and services are created by the labor of individuals and from raw materials that firms purchase from individuals or from other firms. Individuals use their wages to buy goods and services that increase their well-being. State governments, which can buy goods and services, collect taxes, or redistribute income and international flows of labor, money, goods, and services can be included to create an international economic model (Soderbaum 2000). Firms are usually considered the basic units of analysis for economic studies and importantly, firms have certain characteristics that have significant climate change economic implications.

Firms are assumed under neo-classical economic theory to have a unitary objective of profit maximization (DeCanio 2000; Soderbaum 2000). This assumption creates dilemmas from a climate change economic perspective and does not fully represent the real world behavior of business organizations (DeCanio 2000). Global

climate change creates multiple social, political, economic, and environmental problems (IPCC WGII, 2001) that prevent concentration on singular objectives such as profit maximization.

In reality, modern firms have multiple objectives that include increasing market share, improving fiscal performance, preserving good client relations, complying with the values and motivations of employees, and even for some realizing collective goals like preservation of environmental quality. The traditional focus solely on financial performance often creates conflict between sound environmental stewardship and fiscal targets that can be overcome using integrated approaches that incorporate environmental objectives, such as reducing greenhouse gas emissions, into overall operational goals (DeCanio 2000).

Firms are also assumed to focus principally on collective aspects of production such as land, labor, capital, or raw materials, to the exclusion of all other factors of production (DeCanio 2000). The diversity of climate change economic factors that include equity, distributional, sustainability, and income inequality issues (Claussen and McNeilly 2000; DeCanio et al. 2000; Mulder and Van Den Bergh 2001; Roberts 2001; Wiegandt 2001; Baer 2002; Agarwal 2002; Aldy et al. 2003) pose a significant challenge to neo-classical economics. The conventional approach also does not include a full range of options that are available to firms attempting to improve energy efficiency and reduce greenhouse gas emissions. If organizational, contractual, and technological factors of production are not included firms will calculate biased estimates of emission reducing costs, create less than optimal energy and emission

reduction policies, and efforts to learn new approaches for climate mitigation and adaptation will be misdirected (DeCanio 2000).

Neoclassical economic theories of the firm also contend that technological change is the product of exogenous factors that are independent of firm activities (Nordhaus 1992). New studies of technological change dispute this assumption (Romer 1990) and in particular endogenous technological change has been determined to be a key factor that can enable development of new carbon-reducing technologies through industrial knowledge spillovers (Mitrany 1966; Haas 1958; Goulder and Schneider 1999) and government sponsored research subsidies (Sanstad 1999, 2000). Last, the assertion that firms always craft optimal choices contradicts the intrinsic complexity and uncertainty surrounding most economic options. This inherent complexity and uncertainty in turn make precise decision-making difficult and usually less than optimal (DeCanio 2000; Soderbaum 2000). Climate change may be the most complex and uncertain environmental problem the world has ever encountered (Costanza et al. 1997; IPCC WG I, 2001; Schneider and Kuntz-Duriseti 2002). To expect firms to make optimal climate change choices when faced with the enormous complexity and uncertainty inherent in climate change issues using traditional neo-classical economic models is optimistic and obscures the fact that full optimization is difficult to achieve even for very small organizations (DeCanio 2000). Some researchers conclude, “a failure of optimization is the normal state of affairs” when firms face complicated and vague challenges but optimization can be improved using an integrated assessment approach based on a network model of firms (DeCanio 2000, 34). Individuals are also

important agents in the neo-classical model and are also significant actors in global warming economic debates.

Individuals from a climate change economic perspective are the rational consumers of goods and services produced by processes that emit greenhouse gases. The neo-classical economic model assumes that the basic consumer economic objective is utility maximization or maximization of economic well-being (Muller 2001). However, economic utility maximization often ignores the limits of environmental and natural resource systems. The following five examples specify how global limits have been exceeded by economic maximization of ecological subsystems (Costanza et al. 1997; Dasgupta, Levin, and Lubchenco 2000).

First, the global economy uses about 40% of the net primary product of terrestrial photosynthesis and this figure may double in 40-50 years to an unsustainable 80% level as the population of the Earth may double (Vitousek and Mooney 1997; Dasgupta, Levin, and Lubchenco 2000). Second, the degradation of the ozone shield indicates that human activity can damage life-support systems on a global scale. Third, 39% to 50% of the Earth's land has been degraded by human induced transformation, erosion, salination, and desertification (Vitousek and Mooney 1997). Fourth, the species extinction rate has increased 100 to 1,000 times greater than the rate before human dominance of the Earth's ecosystems, threatening to destroy global biodiversity (Lawton and Mays 1995). Last, anthropogenically produced global climate change is changing the biogeochemical cycles of the Earth's atmosphere (Schneider 1997). Researchers have concluded the recent significant increase in greenhouse gas emissions

signify the clearest and best documented indication of human modification of the Earth's ecosystems (Vitousek and Mooney 1997; IPCC WGIII, 2001).

Obviously, international consumer demand has a very significant effect on the supply of global environmental and natural resources and specifically on the range of acceptable atmospheric transformations. Distinctively, the demands by rich, primarily Western consumers for larger homes, multiple cars, parking lots, tall buildings and other accoutrements of Western culture that have directly contributed to global warming fly directly in the face of proven limits to economic growth framed by ecological constraints (Soderbaum 2000; Muller 2001) and the global need for a hospitable climatic system (Costanza et al. 1997; IPCC WGIII, 2001; Agarwal 2002). In relation, another important factor in the neo-classical model of economic actors is the role of information.

According to the neo-classical model firms and individuals are assumed to have complete and perfect information about alternative choices and the impact of those choices (Hawken, Lovins, and Lovins 1999; Soderbaum 2000; Muller 2001).

Nonetheless, consumers and producers do not have all the information concerning the possible choices associated with climate change mitigation or adaptation or the impacts of different climate change mitigation/adaptation paths that consumers or producers may choose (IPCC WGII, 2001). Under the assumption of incomplete information consumers and producers should be more risk averse when making climate change decisions, however the neo-classical model does not integrate scenarios involving imperfect information (Costanza et al. 1997; Schneider 1997; Soderbaum 2000).

Essentially, the complexity of many environmental problems such as climate change

(IPCC WGIII, 2001) magnifies the flawed postulation that firms and individuals possess the crucial information to make optimal informed and competent climate change related decisions (Muller 2001).

In sum, this erroneous characterization of firms and individuals has led to economic calculations of the costs of reducing greenhouse gas emissions that are overestimated, unreliable, biased, and grossly inaccurate (Schneider 1997; DeCanio 2000). In addition, the narrow focus of the neo-classical model only on firms/individuals and their simplistic yet unrealistic features dismisses opportunities for creative, realistic, and actionable climate change mitigation or adaptation policies. As a result, the neo-classical economic model of firms and individuals does not represent the complex behavior of firms or individuals, the uninformed and unlimited demands of consumers and producers, or resultantly, the complex nature of global warming economics.

Central Concepts

Neo-classical economics is based on certain core concepts. These core concepts originate from liberal economic theories, concepts of technological optimism, and prescriptions for continued economic growth. Each of these fundamental principles has key implications for global climate change economic discussions.

Liberal economic theories have influenced neo-classical economic thought in four ways. First, liberals focus primarily on the activities and preferences of individuals (Frieden and Lake 1996). Neo-classical liberal economists contend that the voluntary exchanges between individuals in the market create a situation where everyone can be

made as well off as possible as long as the market is allowed to freely allocate scarce resources.

Second, liberals argue that individuals are rational, utility maximizers (Frieden and Lake 1996). Consequently, neo-classical economists assume people make logical cost-benefit calculations and choose the option that yields the highest level of satisfaction or utility. Also, liberal economists assert that when individuals make exchanges in the market with each other, they each increase their individual utility by basing the exchanges on logical cost-benefit calculations.

Third, liberal economists contend that government interference in the economy should be quite limited (Frieden and Lake 1996). Only certain public goods and services that make society better off that are not provided by private markets should be provided by government. For example, governments should defend the state from invaders and provide the proper foundation for fair, unrestricted domestic and international markets (Frieden and Lake 1996). Private market mechanisms are considered to be better in most aspects than state planning (Hayek 1960; Mitchell and Simmons 1994) because government intervention distorts competitive market processes in inefficient or counterproductive ways (Lobao and Hooks 2003). Specifically, state efforts that are initially designed to advance equal opportunity concerns end up suppressing competition and modernization in the private sector, subsequently retarding financial efficiency and expansion. In essence, government intervention creates a situation where the state program can benefit but only at the expense of efficiency or efficiency, which are usually one of the state's primary objectives (Okun 1975; Lobao and Hooks 2003).

Finally, liberals support the concept of private property (Coase 1960; Anderson and Leal 1999; Soderbaum 2000). Liberals argue that one of the most important roles for government and a key element of the proper foundation for markets is the protection of private property rights (Frieden and Lake 1996) and some researchers advocate privatization of all commodities, including ecological goods and services, through entitlements such as fishing quotas or emission credits (Coase 1960; Anderson and Leal 1999; Muller 2001). The government would then be responsible for allocating and protecting the “property rights to all commodities including the environment” (Muller 2001, 427). These four liberal economic propositions also have climate change relationships.

As noted earlier, climate change debates in some respects are not well served by the neo-classical liberal economic focus on individuals and utility maximization. However, in some respects the neo-classical liberal economic focus on individuals and utility maximization can help explain and describe economic activities and considerations in relation to climate change issues and impacts. It is a given that individual consumers and producers could be greatly impacted by climate change consequences, discussions, and policies (IPCC WGII, 2001). For instance, neo-classical economists would argue that because carbon dioxide is central to energy production in many forms, restrictions to carbon dioxide emissions might cause energy price increases. Global increases in energy prices would be felt throughout the world’s economy. Higher fuel costs would increase operating costs of transportation, agriculture, and especially of industry. Individual households would also see higher energy costs through increases in heating, utility, and transportation bills. Even the cost

of food would be affected by higher energy prices (Weyant 2000). Consequently, consumer and producer utility maximization could be directly impacted by climate change policies. In essence, neo-classical liberal economics factors can effectively describe some of the potential fiscal challenges that individuals may face as they attempt to rationally maximize utility in climate influenced markets. Nevertheless, the liberal preference for limited government intervention may have negative consequences for emerging climate change options.

Ecological modernization supporters have argued that government intervention may be necessary to resolve environmental conflicts such as climate change because it is unlikely that voluntary measures could adequately address the conflict (Mol 1996; Blowers 1997; Toke 2001; Mol 2002). Market interventions like pollution taxes, environmental standards, emission trading schemes, voluntary agreements, or even economic penalties for violations of standards (Toke 2001) could strengthen and legitimize climate related policies. Additionally, economic incentives such as subsidies and permits could sensitively induce producer and consumer acquiescence to climate regime mandates (Dannenmaier and Cohen 2000). In sum, “the role of the state is enabling, establishing a regulatory framework which assists the efficiency of the market and ensures environmental protection” (Blowers 1997, 853). The role of the state in expanding private property rights to public goods may also have negative implications for climate change negotiations and policies.

The global climate is deemed by many to be a common resource and a public good (Baer 2002). As a common resource the global climate is susceptible to harm by one party that subsequently causes harm to other parties and consequently degrades the

public good. As a result, rivalry for control of the resource has ensued and has prompted disagreements concerning allocation of emission rights, proper management procedures, and stymied cooperative efforts required to solve equitably the climate change challenge (Wiegandt 2001).

In response some researchers have advocated privatizing this public good through emission entitlements (Coase 1960; Anderson and Leal 1999; Agarwal 2002) and would subjugate efforts to mitigate climate change to “private individual profit maximization rationale” (Muller 2001, 427). If this occurs the level of abatement may depend upon the ecological aptitude, dedication, and scruples of the individual agents and in conjunction, both producers and consumers, polluters and pollutees, would have incentives to misconstrue or misrepresent the consequences and magnitude of global climate change. No mechanism currently exists to force parties to reveal true costs and preferences and because the number of participants to any global agreement based on private property rights would be in the billions (basically the population of the Earth) and the possibility of a negotiated solution would be astronomically low (Muller 2001). Again in this situation “the larger the coordination problem among individuals, the more government interventions and/or regulations become necessary” (Muller 2001, 428). The second and third central concepts of neo-classical economics involve concepts of technological optimism and continued economic growth.

Technological optimism is a worldview where people assume “that technological progress can solve all future problems” (Costanza 2001, 464). Neo-classical economists integrate this worldview into propositions that economic growth will continue unabated into the future and growth will not be constrained by energy,

resource, or pollution limits (Costanza et al. 1997). Optimists argue that any potential future constraints will be eliminated by ingenious technological developments (Bailey 1993; Simon 1996; Lomborg 2001) and since human systems are fundamentally different from natural systems any resource constrictions can easily be circumvented by technological fixes (Simon 1996; Costanza et al. 1997). However, climate change researchers warn that continued economic growth using the current energy, industrial, and land use processes will result in additional warming by the year 2100 of anywhere from 2.2°F - 10°F (1.4°C - 5.8°C) (IPCC WGI, 2001) (See Table 1 for projected effects of climate change in the 21st Century). Major alterations in atmospheric, oceanic, and terrestrial systems are predicted along with significant transformations of political, social, economic, and environmental organizations (IPCC WGII, 2001). Given that a technological “silver bullet” has not been developed as yet to mitigate global climate change it would appear that the core neo-classical economic concepts of continued economic growth based primarily on technological optimism do not mesh well with the consensus predictions of most of the world’s climate researchers.

Processes

Neoclassical economic theory has many unique processes that differentiate this paradigm from other economic concepts. Each of these unique processes has an association with some of the central global warming processes. Investigation of these processes and their association with climate change issues will further reveal how applicable neo-classical economic theory is to the debate.

Neo-classical economic theory has been described as being mechanistic. Many neo-classical economic processes are described using machine metaphors including supply and demand functions and input-output production process images. The objective is to reduce and simplify complex transactions using generalizations and mathematical symbols (Muller 2001). Also, neo-classical economics is often a process where an economist independently studies a problem, identifies possible solutions, and then disseminates the findings to other economists and interested parties. During the process of analysis the economist often applies reductionist approaches in order to confirm or discover new universal regularities or explanatory physics based laws of how the market performs. An example of the reductionist process is the central position allotted to voluntary exchanges in the market place between individuals as the embodiment of all financial exchanges in the market (Muller 2001). The market is simply the force behind all international economic transactions and processes.

Neo-classical economics is also differentiated from classical economics because of the dogmatic application of mathematical techniques to economic problems. This approach often illuminates unidirectional results or causation at the expense of multi-directional explanations (Soderbaum 2000). The combination of all these processes is personified by “Homo economicus” or economic man, an “artificial creature” that is used to simplify and reduce complex economic realities (Soderbaum 2000; Muller 2001, 421).

Economic man possess obvious, constant, and independent preferences and a consistent, rational decision making process that permits economic man to logically determine the optimal prices needed for a stable, balance of market conditions (Muller

2001). These processes are the mainly the result of an emphasis on objectivity and value neutrality that will be discussed in the next section. All in all these processes have direct implications to climate change economic processes.

Many climate change models are based on neo-classical economic models of the market. The market models are often linear representations of a proposed climate policy. In simple reductionistic terms the net benefits/costs of climate change are equal to the benefits of reduced climate change impacts minus the costs of climate change mitigation. This simplistic, mechanistic, mathematical, reductionistic, market-driven approach is usually derived from only three major variables; (1) cost measures such as GNP, (2) range of impacts considered, and (3) uncertainty of climate change impacts and costs (Weyant 2000). Consequently, the market will determine the costs and benefits of climate change mitigation in a somewhat sterile application of supply and demand considerations.

As a result, most economic approaches do not consider additional variables such as the ancillary benefits of addressing climate change, examples of which are reduction of conventional air pollutants (Burtraw and Toman 2001) or rainforest preservation (Niles 2002). Finally, most economic models assume a simple, mechanical, “smooth behavior” by the climate system where “climate responds slowly and predictably, gradually warming as atmospheric greenhouse gas concentrations increase” (Schneider and Thompson 2000, 59). A realistic model would have to account for the sometimes erratic and always complex nature of the global climate system. The neo-classical concept of economic man also has significant climate change implications.

Each economic man would make independent decisions about the degree of environmental quality, extent of ecosystem protection, and the level of the climate system services they would prefer. However, economic man lacks certain qualities that are essential for making accurate decisions when faced with complex and dynamic issues. In particular, economic man in general does not have the ecological-economic or climate related competence to fully understand, interpret, or assess the complexities of the global climate system and its relationship to the global economic system (Muller 2001). The uncertainties, the non-linear nature, and the dynamics of the climate system continue to baffle the most competent and knowledgeable scientists around the world. Consequently, a utilitarian, rationalistic, and individualistic economic man (Muller 2001) would have great difficulty coming up with an optimal solution to the problem.

Overall, the principal processes that encase neo-economic models and assumptions have limited applicability to the complex, evolving, and multi-dimensional problems that are associated with the climate change debate. Climate change is a progressive challenge that does not easily equate to simplistic, reductionist, mathematical models. The uncertainties surrounding climate change thwart creation of optimal solutions by economic men based on universal regularities. Currently, not enough is known about the complex, intricate, and dynamic global climate system to create an ideal solution simply based on the laws of economics, physics, and other natural sciences (Soderbaum 2000).

Emphasis

Neo-classical economics is centered around two primary points of emphasis. Conventional economists as well as many other scientists tout value neutrality and objectivity as core elements in their approaches to scientific investigation, analysis, and learning (Soderbaum 2000). These two controversial points have created a great deal of epistemological tension in many fields of science (Norgaard 1994) including climate change science.

A researcher that is attempting to maintain value neutrality and be objective is trying to not let his/her personal values, emotions, or prejudices influence the study or analysis of a problem or an issue. Scientists can be objective or value neutral in many circumstances, such as when they are recording temperature readings from a thermometer or when they are determining the concentration of carbon dioxide in the atmosphere at a known location and at a known time. However, there are three shortcomings of neo-classical economics concerning objectivity and value neutrality that have been critiqued by economists.

First, neo-classical economists have disregarded how the original inequitable distribution of rights to resources has affected global markets (Costanza et al. 1997). Most rights to resources in the past were allocated based on differential power situations where more powerful individuals or groups gained disproportionate access to and control over human-made and natural resources. In response, redistribution issues have never been a focal point of neo-classical economics because many conventional economists were convinced that continued economic growth would eventually overcome most of the power driven mal-distribution of resource rights.

Second, intergenerational and intragenerational equity issues have not been a major concern of neo-classical economists (Costanza et al. 1997). Transferring assets from current to future generations has substantial implications for the rich and the poor. The rich need not be concerned with their offspring having enough to survive on in the future but the poor often have to degrade or destroy natural resources and ecosystems just to survive (Costanza et al. 1997). The growth in the divergence between intra-state and inter-state incomes (Passé-Smith 1998) has also been less important to conventional economists because neo-economists believe free markets will ultimately correct income inequality problems as long as economic growth is maintained. Also, distribution concerns can compel creation of a variety of alternative allocation solutions in an efficient market but the formulation of which solution is “best” forces economists to apply subjective values, emotions, and prejudices that thwart mathematical measurement. As a result, deeply embedded division of power problems often cloud moral decision-making and politically charged factors often override equity, distributional, and justness concerns (Costanza et al. 1997).

Last, neo-classical economists rely on projections and assumptions based on the workings of a perfect, efficient market (Costanza et al. 1997; Soderbaum 2000; Muller 2001). In the efficient market everything has a “correct” price based on demand and supply levels. However, when costs or benefits are encountered that do not have set prices or value, (such as pollution costs, benefits/costs of natural ecosystems, or the benefits/costs of biodiversity) the market is assumed to have failed and these costs or benefits are considered externalities from efficient markets operations (Pigou 1920). As a consequence, the perfect, efficient market abstraction has encountered much criticism

for being unrealistic and specifically has been found lacking when dealing with environmental problems (Costanza et al. 1997; Soderbaum 2000; Muller 2001). All three neo-classical economics shortcomings have climate change associations worth exploring.

Since global warming became an international issue resource rights concerns have been critical factors in climate change negotiations (Claussen and McNeilly 2000; Howarth 2000; Mulder and Van Den Bergh 2001; Roberts 2001; Wiegandt 2001; Baer 2002; Agarwal 2002; Ashton and Wang 2003). Climate change is a direct threat to a variety of different global resources and consequently the rights of global citizens to develop these resources is threatened. For example sea level rise puts coastal communities directly at risk and the capital value of their resources, both human-made (ports, docks, resorts, fishing fleets, canneries) and natural (freshwater supplies, beaches, fish, shrimp, and crab stocks) may diminish in worth if sea levels increase (Costanza et al. 1997; IPCC WGII, 2001). A more dramatic example of where resource rights are threatened by sea level rise involves many of the world's small island states, like Tuvalu, Vanuatu, and Fiji. These states could be totally swamped by rising sea levels, permanently foreclosing on any rights to resources and development the residents have (Houghton 1997; Stern 1999; IPCC WG II, 2001; Schneider, Rosencranz, and Niles 2002). For all intents and purposes, most of the poor states around the world do not currently have the resources to mitigate or adapt to significant changes in global climate and past mal-distribution of resource rights continue to aggravate this global dilemma.

Current and future intergenerational and intragenerational equity problems are also key issues in climate change negotiations. Determining what represents a fair response to the problems continues to plague the debate and may be the most difficult question to address (Claussen and McNeilly 2000; Howarth 2000; Cazorla and Toman 2001; Mulder and Van Den Bergh 2001; Roberts 2001; Wiegandt 2001; Agarwal 2002; Baer 2002; Ashton and Wang 2003). The equity question involves multiple unresolved disputes. In particular, all the industrialized states have still not agreed upon what constitutes a fair level of commitment to climate change mitigation or adaptation (Ashton and Wang 2003). Also, the developing states still have not identified how they will contribute to reducing emissions of greenhouse gases because they have serious concerns over how the burden of reducing climate change risks will be shared now and in the future (Cazorla and Toman 2001; Baer 2002). Additionally, because states differ in their vulnerability to climate change, in their ability to absorb the costs of climate change, and in their current and projected emissions of greenhouse gases creating a fair, an equitable distribution of burdens is exceedingly difficult to calculate (Claussen and McNeilly 2000; Cazorla and Toman 2001; Ashton and Wang 2003). In essence the “common but differentiated responsibilities” identified in the Kyoto Protocol have enormous current and future intergenerational and intragenerational equity implications that are not easily addressed by neo-classical economics (UNFCCC 1992, Article 10). Finally, reliance upon the neo-classical market to solve this dilemma may create substantial obstacles to an acceptable solution.

Ecological problems, like climate change, are considered market failures of an otherwise efficient global market. The neo-classical response to this ecological market

failure is two fold. The neo-classical market concept must be “corrected” or “stretched” to neutralize market failures (Muller 2001, 423). Market correction is accomplished by internalization of externalities and market stretching attempts to perfect the market by broadening the concept of property rights (Muller 2001). However, both of these potential market failure remedies suffer from three conceptual weaknesses that also apply to climate change economics.

First, a core neo-classical proposition, the competitive equilibrium concept proposes that for any commodity, even environmental goods and services, there is a set of prices that ensures demand in every single market is equal to supply (Duffie and Sonnenschein 1989). Competition, it is assumed, will lead to efficient allocations of both. Unfortunately this concept is based on a static world with no uncertainty (Radner 1965). Distinctively, climate change is a dynamic and uncertain process, which creates competitive equilibrium problems for environmental commodities such as emission reduction credits or carbon taxes. Correcting the market by internalizing uncertain and dynamic externalities (carbon taxes or emission credits) invalidates the competitive equilibrium concept because the new internal market for environmental property rights is imperfect (Muller 2001). As a consequence, markets may not be able to perfectly internalize some externalities from global warming. The second weakness of the neo-classical attempt to address market failures involves information.

Advocates of market correction argue that government intervention to address an external bad (greenhouse gas emissions) created by an industry or business should be internalized by a Pigovian tax, basically a pollution tax (Pigou 1920). Yet an effective and efficient tax would require substantial release of information by the polluter

concerning activities that are emitting pollution (greenhouse gases), rates of pollution emissions, types of pollution emissions, and this information has to be tied to the damages that the emissions are causing or may cause in the future. The tax also has to be balanced against the level of environmental quality and ecosystem protection that society demands. Individual polluters, behaving strategically, would be very reluctant to release confidential trade information that is essential for setting an optimal tax that competitors could also use to their advantage. Particularly, free-rider concerns (Grieco 1988) could also thwart efforts to create an optimal tax (Muller 2001). Additionally, many of the potential effects from greenhouse gas emissions are still unknown and how the climate will ultimately change and impact internal and external parties is uncertain at best. All sides, governments, businesses, and affected third parties are not adequately informed on the environmental-economic impacts of climate change and do not have all the necessary information needed to create an optimal Pigovian tax (Muller 2001). The third weakness stems from efforts to stretch the private property concept.

Some neo-classical economists propose that market failures can be overcome by stretching the private property concept to include all commodities including environmental goods and services (Coase 1960; Anderson and Leal 1999; Muller 2001). Privatization of environmental goods and services, like climate, would link the issues surrounding their development to the “private individual profit maximization rationale” (Muller 2001, 427). This argument was discussed earlier and basically it is extremely unreasonable to assume that individual owners of environmental private property would possess the perfect and complete information about the dangers of air or water pollution, or the harmful effects of global warming. The neo-classical solution to

market failure would force prices for environmental goods and services, like a benign climate system, to be repositories of economic information and this process would only side step and de-emphasize the natural limits and constraints of a properly functioning climate system. Without a doubt, blindly allowing prices to be indicators of environmental information and knowledge is the primary source of the current environmental crisis that degrades environmental quality and unsustainably develops global natural resources (Costanza et al. 1997; Soderbaum 2000; Muller 2001).

Neo-Classical Economics and Global Climate Change – Summary

Neo-classical economics does not adequately describe or explain the complex environmental and economic interactions that surround global climate change dilemmas. The focus by conventional economists only on firms and individuals ignores the diverse and abundant international actors involved in climate change negotiations. Additionally, the reliance by neo-classical economists on the concept of rational utility maximization by individuals is too simplistic and unrealistic when used to examine a multifaceted global environmental challenge like global warming. Nevertheless, some of the liberal economic concepts that investigate the market induced climate change pressures on consumers and producers do have merit and explanatory power. On the other hand, the unrelenting belief that technological progress will sustain uninterrupted economic growth simply ignores clearly perceptible limits to natural resource development and ecosystem utilization. Modern concerns for international resource

exhaustion and global environmental change have usually assumed a minor position in the development of conventional economics and this is a glaring weakness.

Ecological Economics and Global Climate Change – Introduction

Public concern for the perceived threats to global ecosystems and international scientific acknowledgement that human activities are having detrimental effects on the global environment convinced many economists that a more comprehensive approach to the economic-environmental nexus was needed (Muller 2001). The academic response to the global threats, ecological economics, is at first cut a modern extension of neo-classical economics yet in reality is a more robust, expansive, and transdisciplinary venture into social, political, economic, and environmental issues. Ecological economic literature first appeared in the second half of the 1980s and became institutionalized by publication of new scholarly journals like *Ecological Economics*, the establishment of research centers in Stockholm, Sweden and at the University of Maryland, USA, and by the founding of the International Society for Ecological Economics (ISEE) (Muller 2001).

Ecological economists argue that, “the economic system is a subsystem of a larger ecological life-support system” (Costanza and Wainger 1991, 45). As such, ecological economics is a transdisciplinary field of study that attempts to incorporate views, concepts, and findings from other disciplines to include sociology, biology, zoology, physics, political science, business management, as well as economics,

ecology, and environmental science (Soderbaum 2000). The basic premise behind ecological economics is the development of theories and means for a sustainable society. In this vein, ecological economics:

...analyzes (absolute and relative) scarcity and formulates principles for rational use not only for individual exhaustible and renewable resources (e.g., fossil fuel, fish stock), but also for complex interdependencies of ecosystems, landscapes, or biospheres in their totality. Ecological economics also addresses issues like cost-benefit analysis of environmental policy and the valuation and limitations of monetization of ecological commodities, discounting of the future, perceptions of risk and uncertainty, intra- and intergenerational equity and fairness, and environmental ethics. (Muller 2001, 432)

Ecological economics is not a new separate paradigm dealing with the environment-economic connections but an effort by scientists from many diverse fields of study to reintegrate ecology and economics with the purpose of protecting the well-being of future generations (Costanza et al. 1997). Growing evidence indicates that our efforts to protect the global environment are failing because of the destructive and degrading employment of flawed ecological science concepts, economic models, and equity concepts with regard to people, regions, and generations (Costanza et al. 1997). Accordingly, ecological economics is an attempt to rectify the flaws, correct the failures, and to design and implement a desirable, equitable, and sustainable future for all citizens of the Earth.

Agents

The major agents of ecological economics are based on a stockholder model where the major stockholders are businesses, individuals, scientists, natural ecosystems

and other interested parties (Soderbaum 2000). This is an effort to overcome the limitations associated with the neo-classical theory of the firm where only the profit maximization activities of firms and individuals are considered worth examining. The stockholder concept endeavors to identify all concerned parties that have a “stake” in the ecological-economic issue under discussion (Soderbaum 2000). This approach interacts in interesting ways with the diverse nature of climate change negotiations.

In global warming discussions there a multiplicity of assorted stakeholders that have a great deal at stake if climate change is not rectified. The principal representatives of global citizenry, who all have something at stake if a remedy to climate change is not found, are states. States and the institutions they create are the primary negotiators in the efforts to establish an effective regime. Additionally, many states have allowed non-state actors access to the deliberation process. Non-state actors like NGOs and epistemic communities have become very influential during negotiations (Raustiala 2001). Business, environmental, consumer, and religious non-governmental organizations are all helping set the international climate change agenda, raising awareness of related issues, providing advice and information, monitoring state and international activities, and even assisting in the implementation process for some climate change policies (Raustiala 2001). One of the unique concepts in ecological economics is the broad definition of stakeholders that includes natural ecosystems.

Ecological economics incorporates natural ecosystem welfare into the stakeholder model. The definition of stakeholders is broadly designed to include both human-made capital and natural-made capital for a reason. The complement in many economic situations to human-made capital is natural-made capital and neo-classical

economics assumes that many of the factors of production (human-made capital or natural-made capital) are highly substitutable. However, the supply and productivity of human-made capital is decreasing because the supply and productivity of natural-made capital is decreasing (Lawton and Mays 1995; Costanza et al. 1997; Vitousek and Mooney 1997). As a result, the ever-increasing scale of human activities and the escalating impact this has on natural ecosystems creates a substitution-complement problem (Costanza et al. 1997). For example, if the Eastern US loses many of its deciduous forests as climate zones shift northwards due to global warming (Malcolm and Pitelka 2000), what good are the Eastern sawmills without the forests? Also, if cold water fish like trout and salmon disappear from large portions of their current geographical range due to increasing water temperatures (Poff, Brinson, and Day 2002), what good are fishing boats and fishing industries in these areas without fish? In these examples and many like it, there is no substitute for the natural-made complement if climate change degrades or destroys the natural ecosystem. Fundamentally, ecological limits to production and substitutability were not part of conventional economic calculations and in response natural ecosystems and the natural capital they produce have be included by ecological economists as stakeholders in the process to effectively remedy climate change.

Central Concepts

Ecological economics is based on an interesting and diverse core of central concepts. First, liberal and neo-marxist economic propositions have had substantial influence on the development of ecological economic principles (Costanza et al. 1997;

Soderbaum 2000). Second, ecological economics is based on the concept of technological skepticism (Costanza 2001). Technological skeptics are not anti-technology but do not blindly believe that technology can cure all future problems. Skeptics argue that technological progress is often limited and that the ecological carrying capacity of the planet must not be exceeded. Skeptics also assert that many ecosystems, like the climate system, are complex, non-linear, and can present abrupt and perhaps irreversible changes when pressured (Costanza 2001). Finally, the objective of ecological economics is the well-being of present and future populations not by means of continued economic growth but through sustainable development (Costanza et al. 1997). Each of these core concepts interacts with the struggle to combat global climate change.

The liberal and neo-marxist propositions found in ecological economic principles are a blend of some of the significant concepts contained in these two major economic/political paradigms. The basic liberal economic principles are similar to the ones found in neo-classical economics but, as explained before, ecological economists attempt to rectify the weaknesses identified in the neo-classical principles. However, the primary differences between neo-classical and ecological economists usually lie along neo-marxist lines.

Similar to liberal economic suppositions, individual activities and preferences are major factors in ecological economic assumptions. Just like in neo-classical liberal economics, the voluntary exchanges in the market between rational, utility maximizing individuals are also central factors in ecological economic debates. However, ecological economists specify that logical cost-benefit calculations can be applied fairly

effectively to local situations but other factors must be brought into consideration when regional or global economic-ecological issues are involved (Muller 2001). Ecological economists would differ here by bringing into the discussion not only individual preferences, but neo-marxist concepts of community preferences, the effects of power differentials, and the consequences of global inequities on ecological-economic relationships (Costanza et al. 1997). Individual human and community needs along with ecosystem needs become the focal point of ecological-economic discussions, not just perfectly efficient markets (Soderbaum 2000; Muller 2001).

On the other hand, the liberal economic contention that government interference in the economy should be quite limited (Frieden and Lake 1996) and that private market mechanisms are more effective and efficient than state planning (Hayek 1960; Mitchell and Simmons 1994; Lobao and Hooks 2003) is still considered a major weakness of neo-classical economics by ecological economists. Additionally, ecological economists reject the unbridled liberal support for private property (Coase 1960; Anderson and Leal 1999; Soderbaum 2000) and even the privatization of public goods (Coase 1960; Anderson and Leal 1999) advocated by some neo-classical economists (Muller 2001).

One of the most pressing paradoxes of the climate change debate is the neo-classical economic assumption that technology will permit the continued and unlimited economic growth of the world's economy when it is our technological and economic prowess that has contributed immensely to this dilemma. Ecological economics offers an alternative approach, technological skepticism, to the technological optimism paradox. Essentially, skeptics argue future energy and resource restrictions will not be evaded by application of technological "silver bullets" and this will eventually force

economic growth to stop (Costanza et al. 1997). Many do not consider technology a “silver bullet” either but believe that technologies’ full potential to mitigate global warming through energy conservation and application of renewable technologies has not been fully realized or applied.

Some studies indicate that the US could cut greenhouse gas emissions to 1990 levels by 2010 with no net cost to the economy or even with net economic gain through utilization of existing energy conservation and renewable energy technologies (Berger 2002). Many researchers have also concluded that well designed climate change policies can spur three types of technological change; invention, innovation, and diffusion (Weyant 2000; Berger 2002; Margolis and Kammen 2002).

Investment into energy conservation technologies and renewable energy sources, (wind, solar, geothermal, and biomass) could spur creation of new greenhouse gas reducing inventions, innovation of existing energy conservation and renewable energy technologies, and rapid diffusion of these new processes and technologies throughout the global economy, producing a new international greenhouse gas emissions reduction technologies market. However, as stated before, these new technologies have encountered some barriers to invention, innovation, and diffusion.

Even though renewable and energy conservation technologies have reduced costs and improved efficiency they still have been unable to break into the global energy market and oil, coal, and natural gas remain the main sources of global energy (see Table 5) (Darmstadter 2001; Berger 2002). However, new policies that encourage energy efficiency, promote production of renewable energy sources, and support movement to less carbon-intensive energy sources would dramatically reduce

greenhouse gas emissions over the next twenty years and still permit sustainable economic development (Darmstadter 2001; Jaffe, Newell, and Stavins 2001; Bernow et al. 2002). One estimate of a plan to reduce emissions and increase efficiency concludes that lowering fuel and electricity costs would more than pay for technology innovations and implementations without harming national productivity (Bernow et al. 2002). In particular, the plan's policies have to be broad based, across several sectors, and must include "incentives, standards, codes, market mechanisms, regulatory reforms, research and development, public outreach, technical assistance, and infrastructure investment" (Bernow et al. 2002, 189). Additionally, subsidies to the fossil fuels industries must be eliminated by world governments (Fischer and Toman 2001). Finally, the decline in investment in research and development observed over the last two decades must be reversed and investment into energy conservation and renewable technologies must be increased globally (Margolis and Kammen 2002).

Ecological economists would point out in the above example the importance of using the market to pursue higher, cooperative, community goals that accomplish sustainable economic and ecological objectives. Since resources are limited, cooperation pays and technology can be a force multiplier in the battle to combat global climate change but should not be relied upon as the ultimate answer. Technological developments are known to diffuse and so do social, political, and communal institutional developments (Grubb 2000).

Targeted climate change policies can induce technological developments that lower emission reduction costs and lead to international diffusion of reduced carbon and carbon-free technologies (Goulder and Schneider 1999; Edmonds, Roop, and Scott

2000; Grubb 2000). The process of induced technological change is grounded in the proven concepts of learning-by-doing (Arrow 1962; Grubb, Chapuis, and Ha-Duong 1995), which have been defined as “the incremental improvement of processes through small modifications and adjustments” (Weyant 2000, 24). Climate related studies of technological advancement based on learning-by-doing techniques indicate renewable energy technologies can become competitive and could be able to penetrate global energy economies on a large-scale in the near future (Anderson and Bird 1992; Weyant 2000). In addition to technological diffusion, social, political, and communal developments can also be utilized in the efforts to counter global warming.

The interdependence of the global economy could increase the diffusion of climate change related technology and institutional organizations. Technological diffusion could include increased use of integrated heat and power systems, control technologies, and gas turbines (Grubb 2000). Examples of possible institutional reforms are the elimination of economically undesirable fossil fuel subsidies, liberalization of electricity markets, and policies that encourage increased participation by developing states in emission trading markets. The technological diffusion illustrations and the institutional diffusion cases are examples of spin-offs or spillovers from international efforts by some states to increase energy efficiency and to reduce resource consumption (Goulder and Schneider 1999; Grubb 2000). In essence, “the technologies and choices in one region will inevitably be affected by developments in other regions” (Grubb 2000, 113). Specifically, prudent technological development, especially of renewable energy technologies, and practical application of social, political, communal developments are two of the major avenues on the ecological

economist's roadmap to sustainable development of the global economy. Sustainable development is also a key influence on the struggle to mitigate global climate change.

Ecological economists do not share the same views with classical economists on the relationship between economic growth and sustainable development. Neo-classical economists define growth as the quantitative and qualitative expansion of the economic system. Ecological economists define growth as the *quantitative* expansion of the scale of the physical dimensions of the economic system, while development is the *qualitative* change in a physically non-expanding economic system that is in balance with natural ecosystems (Costanza et al. 1997). As such, global warming is the product of the unsustainable *quantitative* expansion of the scale of the physical dimensions of the fossil fuel based global economic system. Directly, sustainable development concerns are a significant factor in climate change negotiations.

The objective of the UNFCCC is to:

Stabilize atmospheric greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system, within a time frame sufficient to: allow ecosystems to adapt naturally, protect food production, and allow economic development to proceed in a sustainable manner. (UNFCCC 1992, Article 2)

The Kyoto Protocol specifically urges developed countries to help developing countries in “achieving sustainable development and in contributing to the ultimate objective of the convention” (Kyoto Protocol 1997, Article 12). The Protocol places responsibility for this assistance under the guidelines of the CDM, which is designed to encourage developed countries to fund mitigation projects in developing countries. The

CDM is viewed by some as an attempt to address two of the key issues in climate change negotiations and two key issues in ecological economics, equity and efficiency (Costanza et al. 1997; Wiegandt 2001). As such the CDM creates an emissions trading apparatus that could be a cost-efficient solution to reducing greenhouse gas emissions and an equitable way for developed states to transfer financial resources to developing states. Additionally, the goal of the CDM is to balance the needs of developing states for economic growth at a sustainable level with the needs of developed states to maintain quality of life at sustainable levels. In sum, many researchers are confident that policies designed to reduce greenhouse gas emissions coupled with renewable and energy conservation technologies could come from sustainable development policies and vice versa (Weyant 2000; Berger 2002; Margolis and Kammen 2002; Schneider and Kuntz-Duriseti 2002).

Processes

Ecological economics has several key processes that outline the paradigm characteristics. The characteristics also silhouette the key differences between neo-classical economics and ecological economics. Examining the processes in detail will reveal their applicability to the climate change debate.

An ecological approach to economics must be evolutionary by not only assimilating past historical patterns but also by looking to the future for potential developments and changes as ecological and economic systems evolve in tandem. As an evolving concept, ecological economics stresses interaction, dialogue, and learning among the assorted and plentiful stakeholders. In order to accommodate the

requirements of all stakeholders, this interactive methodology stresses the necessity for a democratic ideological perspective. A pluralistic planning and decision making process that embraces competing points of view and beliefs is the only process capable of fairly balancing the needs of weak and powerful parties. Also, ecologically orientated economic planning and decision-making is holistic, not reductionist, focusing on multi-dimensional approaches or analyses. Additionally, controversial and complex issues are best addressed using a systems methodology that operates with the understanding that the interaction of system components is often multi-directional. This holistic line of attack requires not just mathematical analysis but both quantitative and qualitative analysis (Soderbaum 2000). In effect, ecological economic processes appear to have many characteristics required to contend with the complexities and uncertainties of global warming.

Ecological economics also stresses the co-evolution of economic and ecological systems (Costanza et al. 1997). In this sense the human stakeholders are coevolving with the natural ecosystem stakeholders. What humans do to the natural ecosystem affects its evolution and in return the changes in the ecosystems have effects on human evolution. Our values, knowledge, organizations, and technology all affect the environment and change it, but at the same time the organizations, structures, adaptability, and diversity of ecosystems affect human evolution (Norgaard 1994). In relation to climate change, the values, knowledge, organizations, and technology that we apply to the climate change challenge may affect and at the same time be affected by the evolution of the organizations, structures, adaptability, and diversity of global ecosystems. For example, scientific studies in the Arctic indicate walrus, seal, and

whale populations are declining, possibly due to global warming (Tynan and DeMaster 1997). Walrus and seal mothers nurse their babies on sea-ice floes. As temperatures have dramatically increased in the Arctic, sea ice has melted (Johannessen, Shalina, and Miles 1999; IPCC WGII, 2001). Walruses and seals will have to nurse their young farther from the coast and their food sources and must expend more energy pursuing the more distant food supplies. This alteration in rearing and feeding routines may be impacting infant survival rates and adult calorie consumption levels. Additionally, whales are turning up on beaches in record numbers, many in emacipated condition. Scientists have speculated that the whale's food supplies are diminishing due to increases in water temperatures (Tynan and DeMaster 1997). All three animals are vital parts of Inuit and Eskimo food chains and are indispensable elements of their unique cultures. These mammals have been very influential on the values, knowledge, organizations, and technology of Inuit and Eskimo society.

If the whales, walruses, and seals disappear then the Inuits and Eskimos may have to migrate to another area breaking the evolutionary bond they have had with the Arctic. If whales, walruses, and seals populations diminish then the populations of the different species of plants and animals they consumed will probably explode without a major predator to control their numbers. As a result, the organizations, structures, adaptability, and diversity of the Arctic ecosystem may change. Eventually, the evolutionary balance in the Arctic could change and a new equilibrium may be established for the whale, seal, and walrus populations as well as for the Inuit and Eskimo populations and their cultures. The co-evolution of each population might be permanently transformed. This example typifies the holistic, interconnected,

evolutionary nature of the climate change challenge. Therefore, a quantitative economic measure of the impact on the animal and human populations by global warming completely neglects the qualitative changes that climate change forces on human and natural ecosystems. In addition the interactive nature of the association between the large mammals in the Arctic and the Inuit and Eskimo people illuminates a multi-directional relationship where changes of one variable, such as temperature, has multi-dimensional consequences. In response to these compound, multi-dimensional challenges, ecological economics supports an interactive, democratic reply process.

The ecological economics' stakeholder model is based on democratic processes that encourage dialogue, mutual learning, various levels of participation, and accepts multiple power centers and a plurality of competing perspectives and opinions (Soderbaum 2000). For instance, an ecological economic approach to global warming discussions would recognize the climate science specialist as a facilitator and subject matter expert. Additional stakeholders, such as small businesses and multi-national corporations would be encouraged to express opinions and actively take part in deliberations. This ecologically democratic economic approach would also support the views of concerned citizen consumers and energetically recruit their participation in global climate change dialogues. Finally, the decisions of democratically elected politicians based on the will of the people could create an international regime that fairly, transparently, and legitimately addresses the coevolving ecological and economic concerns of all stakeholders (Costanza et al. 1997; Soderbaum 2000).

Emphasis

Ecological economics has two overriding emphases. Advocates of ecological economics argue that values, tastes, and preferences do bias results, conclusions, and findings and this is natural and expected and that subjective interpretation is a key element in scientific investigation, analysis, and learning (Soderbaum 2000). In contrast, the neo-classical paradigm assumes that values, tastes and preferences are unchanging and known however an ecological economic perspective assumes that tastes and preferences do change over time and can be influenced by many factors to include education, advertising, and evolving cultural postulations (Costanza et al. 1997). Subjective understanding at how people arrive at their personal values, tastes, and preferences is an essential emphasis of ecological economics. From this line of thought six value orientated and subjective ecological economic factors continually interact during climate change deliberations. The efficient allocation, sustainable scale, and fair distribution of these economic variables are constantly influenced to different degrees by valuation, choice, and uncertainty factors.

Efficient allocation

When ecological and neo-classical economists describe efficient allocation they refer to the relative division of resources among the possible alternative uses of those resources and contend that a good allocation is an efficient use of the resource. Additionally, efficient allocation is strictly controlled by relative prices as set by the supply and demand forces in competitive markets (Costanza et al. 1997). Consequently, ecological and neo-classical economists contend that the market can be

used to control the prices of climate change mitigation through the efficient allocation of resources.

A mandatory but flexible global greenhouse gas emissions trading market is touted by most economists and climate change researchers as the most cost-efficient solution to this predicament (Petsonk, Dudek, and Goffman 1998; Edmonds et al. 1999; Fischer, Kerr, and Toman 2001; Toman 2001a; Bernow et al. 2002; Goulder and Nadreau 2002). The basic liberal economic approach to emissions trading is that meeting any environmental target at the lowest costs to society is best achieved by allowing the emitters with the highest abatement costs to pay those with the lowest abatement costs to emit less (Fischer, Kerr, and Toman 2001). This concept is based on the highly successful sulfur dioxide control program used in the United States (SO_2 is a precursor to acid rain). The US government established emission limits for each source of SO_2 , made the allowed emission limits tradable on an emissions market, allowed companies to choose the most cost-effective/compliant emission reducing technologies, and then held industries accountable for their emission reduction performance (Petsonk, Dudek, and Goffman 1998). Emission credits are created when an individual emitter reduces their emissions below their allowed level and thereby creates a credit that can be sold to other emitters who need to cover emissions above their limit. This method to control emissions is assumed to level the playing field by controlling emissions from all sources and not singling out different fuel sources, such as just oil, coal, or natural gas. Studies have shown that the costs to states of unilaterally mitigating climate change can be quite costly (Schelling 1997; Michaels and Balling 2000; Nordhaus 2001). However, the costs of mitigating climate change should be substantially lower if global

emission trading is allowed. For example, one study concluded that the costs of reducing emissions in Annex I countries to 1990 levels (as required by the Kyoto Protocol) in a scenario where emission permit trading is not allowed would be approximately \$59 billion per year by 2010 rising to \$112 billion by 2020. In contrast, allowing global trading of greenhouse gas emission permits would reduce costs of mitigation by over one-third (Edmonds et al. 1999). Distinctively, the Kyoto Protocol provides a strong starting position for creation and implementation of a flexible global emissions market.

Climate change negotiations are an evolving process and the current climate regime revolves around the Kyoto Protocol. Even though the Protocol has not come into effect yet, it is viewed by many states as a good first step in a long process of establishing an effective and efficient climate change regime (Bodansky 2001; Mitchell 2001; Goulder and Nadreau 2002; Wiener 2002). Essentially, the unfettered availability of emissions trading created by the Protocol should provide incentives for environmental innovation and cost-savings, create powerful compliance incentives, and give rise to a meaningful, equitable international regime that developing states would join and benefit from (Petsonk, Dudek, and Goffman 1998; Dannenmaier and Cohen 2000). In particular, the Protocol could be the vehicle for efficient allocation of global emission trading permits or rights and valuation, choice, and uncertainty variables would have limited effects on a well-organized, flexible, yet enforceable and compliant emission trading market.

In a structured emission trading market, that is viewed by global actors as legitimate, concern over the value of emission credits would be negligible. Supply and

demands forces in the competitive global market should set prices. Basic choice should be limited to participation or non-participation and the economic costs of non-participation would be very high (Edmonds et al. 1999). Nevertheless, key institutional choices could create uncertainty, affect valuation, and cause prices to arise.

Four factors that could affect uncertainty and prices have been identified. First, states are uncontrolled in how they pursue emission reductions domestically. Studies indicate that a domestic emission permit system compatible with an international trading system would be the most cost efficient (Hahn and Stavins 1999). However, if states choose to employ taxes on greenhouse gases or command and control regulations it is their sovereign decision. The down side of that choice is the domestic system would be less efficient and more costly than the international system and consequently prices may fluctuate between domestic and international systems, thus increasing uncertainty. Second, most neo-classical economic calculations of the global market are based on a perfect efficient market. In reality global emission permits could be subject to reduced availability or demand as a result of regulations or monopolies and this could increase prices and uncertainty. Third, the structure of the international emissions trading regime is susceptible to potentially significant transaction costs (Keohane and Nye 1972, 1977; Goulder and Nadreau 2002). Monitoring, reporting, and verifying costs could negatively affect prices and increase uncertainty if transaction costs are not controlled and transparent (Keohane and Nye 1972, 1977; Edmonds et al. 1999). Finally, the liability, accountability, and enforceability of any global emission system must be accurate and honest (Kerr 2001). Strong comprehensive compliance and enforcement mechanisms may alleviate some liability and accountability concerns and

bring stability to prices and thus decrease uncertainty (Edmonds et al. 1999; Wiener 2002). All these concerns have been discussed in climate change negotiations and as noted above many of the problems have been positively addressed in the Kyoto Protocol.

Sustainable scale

Sustainable use of natural resources is determined by the scale of their use in relation to the natural regenerative capacities of the natural system. The ability of an ecosystem to regenerate inputs and absorb waste outputs on a sustainable basis are based on ecological limits that determine the ability of the system to continue to function effectively and efficiently at a stable level (Costanza et al. 1997). The global climate system obviously operates on a worldwide scale and the focus of most climate scientists is on the global carbon cycle within the climate system.

The atmosphere has traditionally been used to dump the gas and particle wastes of modern industry and this has altered the radiant energy exchange between the Earth's surface and outer space. Carbon is the key element of two primary greenhouse gases, carbon dioxide and methane (CO_2 and CH_4) and these two gases are bases for most fuels used in transportation and for power generation. Additionally, carbon composes about half the dry weight of most plants and is released during a variety of different land use processes. Accordingly, carbon constantly cycles through the air, water, soils, and living matter and is both an essential nutrient for life and a potential threat to life. Humans have been enhancing the natural greenhouse effect these gases produce and have modified the carbon cycle to such an extent that the climate system may soon

exceed the survival limits of human and natural ecosystems (Schneider, Rosencranz, and Niles 2002). The scale is global, alteration of the cycle of carbon inputs and outputs is unsustainable, but the international response is tempered by three variables: valuation, choice and uncertainty.

Ecological economists do not all agree that valuing ecosystems is a good idea. Some argue that you cannot place a price on intangibles like the beauty of nature or ecosystem goods and services. Others contend that ecosystems are valued everyday as people make personal and economic decisions on what they buy, where they live, and the lifestyle they choose (Costanza et al. 1997). Nevertheless, the value of the goods and services that the climate system provides is an international concern. Two significant kinds of value impact decisions on the worth of the global climate system.

The climate system may be valued for the current or short-term goods and services that it provides or for its long-term, sustainable worth to mankind (Costanza et al. 1997). Most climate researchers argue that global warming is naturally a long-term dilemma because most of the impacts of climate change will not be observed for possibly decades or centuries (IPCC WGII, 2001; Schneider, Rosencranz, and Niles 2002; Pershing and Tudela 2003). As a result researchers assert that establishment of a long-term climate target either based on quantitative limits to greenhouse gas emissions, limits on greenhouse gas concentrations, or even limits to increases in global mean temperatures is a priority for a functioning global climate change regime (Pershing and

Tudela 2003). A long-term target would provide the following benefits:

1. Create a concrete goal for current and future climate efforts.
2. Increase awareness of the long-term consequences of human actions.
3. Create a metric for calibrating short-terms goals.
4. Induce technological change by sending stable signals to markets.
5. Create some assurance that undesirable outcomes will not take place.
6. Mobilize society including the private sector, individuals, and NGOs.
7. Promote global participation. (Pershing and Tudela 2003, 14)

Many of these benefits are in line with key ecological economic processes.

Setting future goals and metrics acknowledges the evolutionary aspect of climate change. Also, increasing awareness recognizes the need for interaction, dialogue, and learning during climate change deliberations. Mobilizing society and promoting global participation identifies the requirement for constant application of democratic principles to the holistic problem of global climate change. Additionally, increasing awareness, setting goals, and establishing metrics integrates both the qualitative and quantitative features of this international dilemma. Inducing technological change reaches back to the roots of ecological economics, neo-classical economics, and demonstrates an understanding of the power of the market to produce innovations and technological improvements that can directly mitigate climate change. In all, a long-term target recognizes the enormous scale, complexity, and multi-directional challenge that global warming presents and addresses it using a democratic, evolutionary, and holistic solution.

A second aspect of the broad and long-term scale of climate change is the choices that will be made. Mitigation may require transforming many strongly held international beliefs about how we produce and consume energy, how we transport our

goods and ourselves, how we utilize land and forests, and how we build and use, for example our roads, buildings, or communication systems. Possible climate-friendly choices include increased use of natural gas, deployment of efficient electricity production technologies (combined heat and power systems or fuels cells), enlarged exploitation of renewable energy technologies, application of energy efficient technologies in buildings and industry, more energy efficient vehicles, or employment of carbon sequestration techniques (Smith et al. 2002).

Essentially, the scale of the alterations to the planet as a result of global warming coupled with the diverse impacts and costs of the possible solutions to this worldwide impasse create a challenge that is of an entirely different order of magnitude than has ever been encountered in the history of efforts to address international or regional environmental problems (IPCC WGII, 2001; Schneider, Rosencranz, and Niles 2002; Pershing and Tudela 2003). The third variable that influences the scale of the global warming dilemma is uncertainty.

Climate change inherently has long time horizons that create many scientific uncertainties (Pershing and Tudela 2003). Extensive uncertainties concerning the costs of mitigation or adaptation exist because of the uncertainties of global climate change itself and its consequences (Weyant 2000). Additionally, there are concerns for the less likely and unexpected impacts of “climate surprises” or low probability, high consequence events (Schneider and Thompson 2000, 59; Schwartz and Randall 2003). Clearly to many researchers and policy-makers, the scale and uncertainty of this quandary are not forces for inaction but, on the contrary, are forces for action (UNFCCC 1992; IPCC WGIII, 2001; Shogren and Toman 2001; Holden 2002;

Schneider and Kuntz-Duriseti 2002). In particular, “the odds of climate change impacts being much worse than currently expected are high enough to justify buying insurance against those outcomes. ‘Insurance’ in the form of early additional control (of greenhouse gas emissions) provides a cushion in case the impacts of climate change do, in fact, turn out to be worse than currently expected” (Weyant 2000, 28). This type of environmental “insurance” has often come under the guidelines of the precautionary principle.

The precautionary principle has been defined generally as when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully understood scientifically (Wikipedia 2004). It includes taking no action in the face of uncertainty; shifting burdens of proof to those who create risks; analysis of alternatives to potentially harmful activities; and participatory decision-making methods (CIEL 1991). In particular the UNFCCC states:

Parties will take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost. (UNFCCC 1992, Article 3)

As stated before, this principle has been described as an insurance policy used to protect against unexpected, large scale, catastrophic events, like global warming (Houghton 1997). Ecological economists would accept and encourage its application because the “size of the stakes” are too high to act otherwise (Costanza et al. 1997,

146). In sum, the scale of the climate change challenge is so large that only through a prudent, democratic decision-making process that integrates the needs and wishes of all stakeholders can a sustainable international solution be arrived at.

Fair distribution

Ecological economists describe distribution as the relative division of resources, goods or services among different people. A good distribution of resources, goods or services is one that is deemed just or fair in that it limits the degree of inequitable division. Often the policy instruments used to redistribute resources are taxes and welfare payments (Costanza et al. 1997). Importantly, fair distribution is the most prominent debate in climate change negotiations today.

The UNFCCC contains basic principles that are often found in environmental law but are also primary tenets of liberal democracies and ecological economics. The UNFCCC states that “change in the Earth’s climate and its adverse effects are a common concern of humankind” (UNFCCC 1992, 2). This principle recognizes that all of global society, regardless of national origin, is equally threatened by climate change and deserving of protection. Furthermore, the UNFCCC goes on to conclude that the “largest share of historical and current emissions of global greenhouse gases has originated in developed countries” (UNFCCC 1992, 2). Obviously, the UNFCCC is very transparent in assigning liability for the worldwide dilemma to the developed states of the world.

All parties to the Kyoto Protocol have acknowledged that global warming and accompanying environmental damages are the result of activities occurring

predominantly in developed countries (UNFCCC 1992; Kyoto Protocol 1997; Wiegandt 2001). The developed states, in general, also accepted responsibility for alleviating the problems created by climate change when they acknowledged “common but differentiated responsibilities” due to the global nature of climate change (UNFCCC 1992, Article 10). However, developed states are also concerned that rapid population and economic growth in developing countries could lead to higher per capita income and consequently higher greenhouse gas emission rates (Toman 2001; Wiegandt 2001; Agarwal 2002). In response, developing states have claimed that the “common but differentiated responsibilities” is such a “very diluted version” of the “polluter pays” principle that it allows the developed states to disregard historical emission levels and the inequitable consequences of climate change (Agarwal 2002, 380). Additionally, developing states assert this acknowledgement has not stopped developed states from engaging in games where they try to minimize their economic sacrifices while trying to maximize the fiscal requirements of developing states (Soroos 2001). As noted before, these dueling concerns create controversy over equity, property rights, and principles of justice, economic welfare, natural resource development and other core ecological economic issues.

The UNFCCC states, “The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common, but differentiated responsibilities and respective capabilities” (UNFCCC 1992, Article 3(1)). The Convention embraces a just, impartial, and fair distribution of emission reduction requirements led by developed states along with an impartial accounting for the special needs and circumstances of developing

countries. These core liberal democratic ecological economic concepts of justice, impartiality, and fairness (Zacher and Matthew 1995; Costanza et al. 1997) exemplify the efforts by negotiators to create an international regime that fairly addresses the uniquely individual responsibilities and capabilities of each state (Wiegandt 2001). Two essential concepts of justice and equity are also represented within the climate change regime building process.

First, implications of retributive justice or a “polluter pays” principle is evident in climate change negotiations. This ecological economic concept is aptly expressed in Principle 16 of the Rio Declaration from the 1992 UN Conference on Environment and Development, (also known as Agenda 21) which states:

National authorities should endeavor to promote the internationalization of environmental costs..., taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard for the public interest and without distorting international trade and investment. (Rosenbaum 2002, 354)

Consequently, retributive justice concerns have been explicitly included in several articles of the UNFCCC and Kyoto Protocol (UNFCCC 1992, Article 3, 4, and 7; Kyoto Protocol 1997, Article 3 and Preamble). A major additional factor in this discussion is an argument supporting stronger intra and intergenerational equity legislation in climate change policies that is based on the Rawlsian “veil of ignorance” concept where present generations have major obligations to future generations (Rawls 1973; Paterson 2001; Wiegandt 2001). For example the Alliance of Small Island States advocates establishment of a retributive international fund paid for by the states that have caused global climate change to compensate those states that could

disproportionately suffer future consequences of global warming (Paterson and Grubb 1992; Paterson 2001). The second judicial concept, distributive justice, argues that climate change policies should also address existing international inequalities (Paterson and Grubb 1992; Shue 1999).

The issue of distributive justice has evolved along two lines of thought: should the burdens of reducing emissions be equally shared and how should the developed states help the developing states minimize the growth of greenhouse gas emissions without harming their dire need for increased economic growth (Paterson 2001). The clear consensus is that the primary costs of reducing emissions must be borne by developed countries but debate over the future distribution of emission limits over the long term has caused international dissension during negotiations (Paterson 2001; Soroos 2001). In addition, negotiations over emission reductions have also raised concerns over how the technological and financial transfers specified in the Convention help developing states minimize their emissions and even if the transfers specified will help reduce emissions (UNFCCC 1992, Article 4(7)).

Distributive equity supporters endorse substantial transfers of financial resources and technology from developed states to developing states because the developed countries have caused global climate change and the developing states cannot slow economic development because further development is needed to alleviate wide spread poverty (Paterson 2001; Soroos 2001). The stated purpose of the JI projects and the CDM is to provide financial resources and technology transfers to developing states and both these flexibility mechanisms reflect acceptance of equity, justice, and economic

efficiency principles by the developed states (Paterson 2001). As stated before, the CDM in particular is viewed as a convergence of two key ecological economic concepts, equity and economic efficiency (Wiegandt 2001).

The CDM encourages trade and transfers between developed and developing states and advocates the cost effective benefits found in an international emissions trading regime. However, developed states have yet to provide any substantial assistance, financial or technological, to developing states (Paterson 2001; Soroos 2001). Some developed states are arguing that a well-defined carbon tax system and/or an enforceable emissions trading process to flesh out JI projects and the CDM is needed before transfers can begin (Paterson 2001). Additionally, developed states are also concerned that the costs of financial assistance and technology transfers could be expensive, perhaps as high as \$100 billion per year (Paterson 2001). Some studies indicate that a global emissions trading program could result in significant transfers of wealth between some states and regions (Edmonds et al. 1999), but not even close to the \$100 billion level.

One economic model indicates that the US would send about \$8-\$8.5 billion dollars abroad in the year 2010 to buy emission permits. As a consequence, a variety of developing states would greatly benefit from the transfers. For example, under a world emission trading regime parameter, Russia and Eastern European states would receive \$1 billion in 2010, China would receive \$7 billion, and India would receive over \$4 billion (Edmonds et al. 1999). These transfers would be a sizeable benefit for all these states that could lead to considerable convergence of income inequality (Passé-Smith 1998).

In line with the previous model, the economic solution receiving the most international support is a global market for tradable emission permits, that would efficiently facilitate financial and technological transfers to developing states, minimize costs to the developed states, and cost-effectively provide climate change mitigation (Paterson 2001; Wiener 2001). Modeling of economic considerations also illuminates fairness, justice, and equity issues and clearly point out the salience of ecological economic principles to the climate change regime.

Fair distribution climate change issues can be examined along five dimensions of equity (Ashton and Wang 2003). First, as noted before, climate change equity involves major discussions about who is to blame for this predicament. These deliberations usually evolve into debates about the previously discussed “polluter pays” principle (Rosenbaum 2002). Responsibility has been accepted by developed states to some extent but additional intra and intergenerational equity concerns continue to plague development of new climate change policies (Paterson 2001; Wiegandt 2001). Second, egalitarian arguments of who is entitled or has rights to certain public goods have also become equity arguments (Baer 2002; Wiener 2002; Ashton and Wang 2003). Public goods like liberty, security, justice, opportunity, and specifically the entitlement to emit greenhouse gases are everyone’s concern.

In particular, disagreements continue over how emission entitlements or permits should be distributed (based on current emissions or on future emissions) and what the entitlements should be based on (per capita emissions or per country emissions) (Fischer, Kerr, and Toman 2001; Agarwal 2002; Baer 2002; Ashton and Wang 2003). Third, who should respond to the climate change challenge? Should the states most

able to respond contribute the most efforts to a solution because they have the most capacity to act (Claussen and McNeilly 2000; Ashton and Wang 2003)? Fourth, some states are less well endowed in their ability to meet their citizen's basic needs. A fair resolution to this dilemma would expect the stronger, more capable states to help the weaker states meet basic needs that are threatened by climate change (Claussen and McNeilly 2000; Agarwal 2002; Ashton and Wang 2003). Last, a fair solution to this problem would ensure that no states can free ride. All states must contribute based on their level of responsibility, entitlements, capacity, and basic needs in relation to the level of responsibility, entitlements, capacity, and basic requirements of other states (Claussen and McNeilly 2000; Ashton and Wang 2003, 63-64). In addition to the factors just discussed, the equitable distribution of climate related efforts and costs is also influenced by valuation, choice, and uncertainty concerns.

Climate change creates equitable valuation and uncertainty concerns along four prominent "domains of choice" (Ashton and Wang 2003, 67). First, equity is a factor in determining what actions should be taken to reduce emissions of greenhouse gases. This choice entails responsibility, entitlement, and comparability of effort questions that could influence the valuation of any market process used to reduce emissions and could heighten uncertainty. However, assigning greater obligations to prosperous states with high relative levels of per capita emissions and requiring developing states as they become more advanced to assume more obligations could stabilize valuation and reduce uncertainty concerning emission reduction actions (Baer 2002; Ashton and Wang 2003).

Second, the consequences of climate change also create considerable equity problems. The harmful effects of climate change pose great threats to the basic needs of the poorest states. Essentially, the poor states hold the rich states responsible for climate change (Agarwal 2002). Also, the rich states have more capacity to deal with the harmful consequences of climate change than undeveloped states. As a result, climate change consequences create inequitable valuation and uncertainty problems for developing countries that the developed states do not face. These concerns can only be rectified with a strong, flexible, comprehensive, and equitable climate change regime (Baer 2002; Ashton and Wang 2003). One of the possible rectifying principles of the new regime, as discussed before, could involve a third choice, resource transfers.

Any transfers of wealth automatically induce equity dilemmas. The current climate change regime instruments have created processes for transferring funds, technology, and knowledge to developing states. However, measures of responsibility, capacity to act, and level of basic needs soon become political questions and with politics there are difficulties determining fair values for transfers and general uncertainty of when and from where (Ashton and Wang 2003). Again, the global climate change regime must continue to address these challenges and create well-built, supple responses.

Fourth, even the climate change negotiation process has equity implications. Again, during negotiations developing states have accused the US and EU of joining forces, overcoming their differences behind closed doors, and then offering a *fait accompli* proposal to developing states (Agarwal 2002). Additionally, most developing states have very limited capacity to participate in climate change

negotiations while developing states provide much of the scientific advice and assessments. Consequently, most developing states will not play a part in climate change negotiations until developed countries reduce emissions, burden-sharing issues are finalized, and technology transfer and financial assistance programs are visibly established (Paterson and Grubb 1992; Cazorla and Toman 2001). In all, the negotiation process must be viewed as transparent, fair, and open to all parties or uncertainty and mistrust could deadlock cooperation.

In sum, equity or the fair distribution of resources, goods, and services is the primary stumbling block for current negotiations. The problem remains that “there is no ‘single truth’ about equity—no unique mathematical solution to the equity equations” (Ashton and Wang 2003, 82). Differing levels of political judgment, vision, and leadership that often produce disagreements on valuation, choices, and increase uncertainty often cloud perceptions of what is fair and just. In the end, “room must be left for politics and interests” (Ashton and Wang 2003, 82).

Ecological Economics and Global Climate Change – Summary

Ecological economics is overall a balanced approach to environmental and economic problems. Ecological economists openly recognize the complexity, urgency, uncertainty, and finite aspect of global environmental problems, like global warming. As a result, ecological economists recommend a proactive process that investigates the underlying forces that drive economic system, natural ecosystem, and climate system interactions. Specifically, the agents, central concepts, main processes, and primary

emphasis of ecological economics indicate the proactive, transdisciplinary orientation of this new paradigm is very applicable to the climate change impasse.

The inclusion of multiple stakeholders like corporations, scientists, citizens, and natural ecosystems provides an opportunity for all groups with a stake in climate change issues to express their concerns and interests and influence the process. The central concepts of ecological economics (a blend of liberal economics and neo-marxist concepts, a focus on technological skepticism, and a spotlight on sustainable development) give ecological economics a broad, flexible, and even-handed core that is uniquely applicable to this debate. The main processes of ecological economics also give the concept a modern, progressive, and fluid approach to the nexus between climate change impacts and costs. Additionally, ecological economists stress the need to understand the historical and evolutionary patterns of climate events. An open-ended, holistic, systems approach to the quantitative and qualitative features of global warming issues rather than a closed, mathematical methodology exposes ecological economists to different images, solutions, and relationships than traditional economists encounter. In addition, ecological economists support democratic problem-solving and decision-making processes based on interactive dialogue and participation. Perhaps the most appropriate problem-solving and decision-making processes available to counter this challenge. Finally, the understanding that climate change research and science is influenced by values, objectivity, and subjectivity permits ecological economists to tackle the toughest climate change issues, like international equity controversies.

Economics of Global Climate Change – Conclusions

The disequilibrium between rich and poor and the economics of climate change could soon force a paradigm change. Neo-classical economics, unlike ecological economics, lacks the appropriate concepts and principles needed to explain, describe, or predict climate change related events. In particular, this investigation has highlighted and isolated the weaknesses and strengths of each paradigm.

The range of agents studied by neo-classical economics is too limited. The climate change dilemma involves multiple actors beyond firms and individuals and this limitation weakens the applicability of neo-classical economics. Additionally, the reliance by conventional economists on the central concept of technological optimism puts the paradigm at great risk. The confidence in future human ingenuity has become such a core belief for neo-classical economists that factors such as risk and uncertainty, major factors in climate change, are undervalued in the assumed perfect, efficient market models. The technological optimism drives another dependence that further weakens the neo-classical economic paradigm. The unrelenting belief in continued economic growth ignores the natural limits of natural resources and ecosystem services. In particular, implacable confidence in continued economic growth does not take into account the enormous scale and impact humans are having on our planet. The core processes that conventional economics rely upon highlight the internal flaws of the neo-classical approach.

A mechanistic, reductionistic, mathematical methodology that underrates or disregards the complexity, multi-dimensionality, and inherently uncertain features of ecological/economic problems, perfectly represented by global climate change, is too

simplistic and unrealistic to be effectively applied. Essentially, the most glaring weakness of neo-classical economics is the failure of the paradigm to effectively address or recognize the direct influences of values, beliefs, and prejudices on science and research in general and their particularly strong influences on studies of this predicament. Neo-classical economics fails to confront power differentials and equity issues and this breakdown may force a paradigm change. The international equity issue must be addressed using the precepts of ecological economics and several conditions must be met before a fair and just climate change regime can be created.

First and foremost, the world's most effective democracy, the US, must join the international effort to mitigate or adapt to climate change. The effort will probably not succeed without emission reduction commitments and leadership from the US (Ashton and Wang 2003) and accordingly a holistic approach to this challenge that includes as many stakeholders as possible. Additionally, creating a prudent, risk-adverse community of interested parties that understand and appreciate the power of liberal economics and acknowledge the limits of human ingenuity and ecosystem services could energize mitigation and adaptation efforts and as a by-product unleash many sustainable development policies.

In addition, as a whole, the developed countries of the world must supply fair and unbiased leadership. Interaction, dialogue, and learning about global warming must all occur within a transparent, all-encompassing international regime that developed and developing states must help build. Probably the most controversial condition for success is the meaningful, democratic participation of some key developing states

(Ashton and Wang 2003). In particular China, India, and Brazil must participate significantly in international negotiations if they are to be successful.

Another condition that must be addressed is development of effective methodologies for adapting to and mitigating climate change. This not only includes quantitative efforts like financial and technology transfers but also qualitative efforts such as resettlement of populations displaced by global warming. Of particular note is that mitigation efforts may power the equitable redistribution of resources, finances, and knowledge and enable the convergence of income inequality around the globe. Finally, the developed states should invest in the capacity of the developing states to participate in international negotiations (Ashton and Wang 2003). Training and human resources assistance is critical for developing states to participate meaningfully in open, transparent, and inclusive dialogue. The values, beliefs, and prejudices of all stakeholders must be accounted for and incorporated in an equitable, democratic, pluralistic, reciprocal global process. In conclusion, the ecological economic paradigm explains, describes, and prescribes climate change events more fully and completely than the neo-classical economic paradigm.

CHAPTER VI

CONCLUSIONS – THE CATALYST, DISEQUILIBRIUM, AND PARADIGM CHANGE

The Global Climate Change Catalyst

Global climate change is now the dominant environmental dilemma confronting civilization. It also involves many secondary and tertiary issues that often confound investigators and these issues add complexity to an already intensely complicated political, social, economic, and scientific phenomenon. Is the Earth warming because of anthropogenic processes? If so, how much and how fast will the Earth warm? What will be the affects on humans, plants, and animals? Will global warming change the climate in a beneficial or detrimental way? If global warming is going to happen can it be slowed, reversed, or even stopped? Should global warming be slowed, reversed, or even stopped? How much will it cost to stop climate change?

The consensus of most the world's climatologists is that global warming is essentially an anthropogenic process that will probably cause the world to warm from 2.2°F - 10°F (1.4°C - 5.8°C) by the year 2100 (IPCC WGII, 2001). As a consequence, sea levels will probably rise (IPCC WGII, 2001) and some plants and animals could become extinct (Thomas et al. 2004). Overall, researchers conclude most consequences of climate change will probably not be benign, climate change cannot be stopped, and as a result global efforts are needed to mitigate or adapt to the consequences (IPCC WGII, 2001). As a result, the costs of mitigation or adaptation could be substantial or

the costs could be moderate, depending on how the challenge is addressed (Toman 2001; Aldy, Baron, and Tubiana 2003). In effect, global climate change is an environmental force, a catalyst for change that must be reckoned with soon, very soon.

The changing climate is an environmental catalyst that could precipitate political, social, and economic transformations. Politically, the consequences of global warming could hasten a replacement in the dominant international relations paradigm. Realism may be replaced by liberalism as the preeminent theory of international relations used to explain world events, especially international political events related to global warming. Socially, the impacts of global climate change might drive the dominant social paradigm from its perch as the most applicable social environmental paradigm. Explanations, descriptions, and predictions of current and future international environmental societal events could be based primarily on ecological modernization concepts. Last, the reign of the neo-classical economic paradigm may come to an end. Essentially, ecological economics can answer the environmental-economic puzzles created by global warming more completely than conventional, neo-classical economics.

These changes could occur because a previously balanced force of nature, the global climate system, is being altered and is becoming less stable or predictable. The consequences of the change in global climate system equilibrium could affect mankind on an enormous scale and through a wide variety of impacts never encountered before. As a direct result, the consequences of global climate change could influence the equilibrium between the world's dominant political, social, and economic paradigms.

International Relations Disequilibrium

A world dominated by free trade, interdependence, prosperity, freedom, peace, and environmental concerns is the most accurate description of the world that is being challenged by global climate change. Directly, a liberal worldview is more applicable to the debate. A liberal worldview explains and describes aspects of the challenge more precisely and entirely than the realist worldview. The key actors of the liberal paradigm embody the major players involved in solving this predicament and will probably also be the agents most affected by global climate change. The central motivations of liberalism also exemplify the major international relations concerns and threats created by global warming. Accordingly, liberalism openly attends to and attempts to rectify this most urgent danger to the international system.

Global climate change increasingly threatens the freedom and economic well-being of individuals, groups, non-state actors, and states, around the planet. A paradigm that is essentially state centric excludes many of the major actors in a global society that could unequally suffer the consequences of global warming. Progressive liberal concepts could be uniquely pertinent to investigate the evolving, dynamic, non-linear nature of this dilemma. Also, liberal propositions could be exceptionally qualified to analyze the multidimensional social, political, economic, and environmental challenges induced by global warming. Finally, the liberal Kantian variables of democracy, international organizations, and free trade could provide a proven political ideology to guide the efforts to counter this global threat. These variables could also be the underpinning for worldwide social and economic structures that may lessen the

negative impulses that arise from international anarchy and security dilemma concerns. In essence, these three liberal forces lay the foundation for collaboration on and creation of an international climate change regime.

Democratic processes and international organizations are needed to implement the difficult, expansive, and complex policies needed to mitigate or adapt to global climate change. Democratic processes could ensure the necessary policies are the will of the people, are transparent, and are perceived as legitimate. International organizations could reduce transaction costs and uncertainty and provide a structure that can determine accountability and liability and ensure accurate, honest monitoring, verification, compliance, and enforcement of climate change policies. Free, open, and competitive trade would ensure supply and demand processes are applied to a greenhouse gas emissions trading regime so that the most cost-effective and cost-efficient prices are generated. Additionally, free trade may induce technological innovation and diffusion of climate friendly and energy conserving products and services. In the end, global climate change may compel a credibility crisis in the international relations and political science community that could result in the replacement of the dominant international relations paradigm, realism with the liberal paradigm.

Social and Natural Paradigm Disequilibrium

Global climate change may force a dramatic paradigm shift from the dominant social environmental paradigm to a new environmental social paradigm. As such, ecological modernization is the most applicable social paradigm for environmental

issues like global warming. In essence, the major agents, emphasis, central concepts, primary outputs, and typical forecasts of ecological modernization are more germane to the debate than the assumptions of the dominant social paradigm.

The forces supporting the dominant social paradigm have put the world on the path to global warming and the ecological modernization paradigm offers a realistic alternative social path to pragmatically resolving this quandary. Ecological modernization advocates offer a broad approach to environmental challenges, an approach that is not solely focused on the activities of firms or the interactions of the state, economic classes, or environmental movements. This expansive approach enlarges environmental change discussions to include economics, politics, and societal issues. Ecological modernization supporters recognize that the dominant social paradigm is inadequate to create the processes, methodologies, or policies needed to mitigate or adapt to global climate change. International economic institutions accountable for this predicament must be reformed and reintegrated with the institutions that protect and preserve the global environment. Additionally, the needs, goals, and objectives of both the ecological and economic sphere have to be recognized, compromised, and balanced.

Ecological modernization activists understand that the processes required for the restructuring of the industrial, agricultural, and ecological systems that contribute to global warming are found predominantly in the development of new climate friendly technologies and in the discovery of new energy efficient services. Additionally, profit margin and market share considerations must receive equal precedence with ecological requirements and constraints. The motor of climate change mitigation and adaptation is

sustainable economic growth and prudent technological innovation. The harmful impacts of global warming can only be controlled and reduced through global cutbacks in greenhouse gas emissions coupled with creative technological efforts. As stated before, the development and distribution of new climate friendly energy sources, the implementation of carbon-free transportation options, and the application carbon sequestering land use choices would significantly reduce emissions. Market mechanisms that incorporate the ecological goals espoused by ecological modernization advocates have been successful at the regional level and can work at the international level to mitigate global warming.

One of the advantages of the reasonable, conservative, practical, and hopeful ecological modernization approach to remedying global climate change stems from the high probability of acceptance by global society, which would be dramatically less accepting of a radical anti-capitalistic revolutionary approach. Although standard operations of the global economy have forced the world's climate into this quandary, exploiting the immense power of global markets and channeling the original and inventive powers of science and technology toward resolving this dilemma may not only address this global challenge but could have important spill-overs. Encouraging economic and ecologically concerned actors to work together on solutions to the impasse may generate synergistic forces that would embed critical environmental objectives deep into previously anti-environmental economic processes. Reconciliation, reintegration, and reformation are the action words that describe key ecological modernization processes and are the decisive actions required to mitigate or adapt to global climate change. Finally, it should be reiterated that the primary purpose of

ecological modernization is “neither to overthrow nor to kneel at the altar of the market. The aim is to harness market forces by a practical governance that delivers both economic prosperity and social justice” (Curran 2001, 44) and hopefully a solution to global climate change.

Rich and Poor – Economic Paradigm Disequilibrium

The disequilibrium between the world's rich and poor may be exacerbated by global climate change. As a result, neo-classical economics' inability to provide accurate and specific analysis, examination, or prediction of global climate change events and issues could result in its replacement by ecological economics as the dominant economic paradigm. Accordingly, ecological economics recognizes the highly applicable agents, concepts, processes, and emphases required to accurately explain, describe, or predict climate change driven activities, processes, or consequences.

Ecological economic supporters acknowledge the broad range of agents that are implicated in debates about climate change and attempt to work with all stakeholders in a pluralistic approach. Neo-classical economists failed to recognize or accept that there are innate limits to natural ecosystem outputs and processes. Blind reliance on pure mathematical economic calculations based on assumptions that economic growth is unlimited do not pass the reality test. Specifically, the ability of natural systems to regenerate or survive constant development pressures has been brought into doubt by the emergence of critical global environmental change dilemmas like the disintegration of the stratospheric ozone shield, the decimation of global biodiversity as a result of

growth related extinction of 100s to 1000s of species per year, and of course the dangerous anthropogenic changes to the global atmosphere. The blind trust in the mathematical certainty of unconstrained economic growth is bolstered by an equally sightless dependence on human creativeness and inventiveness to somehow fix all of the problems of the world. A more prudent, risk-averse approach advocated by ecological economists would prevent scrambling after the fact to find cures and remedies for industrial or economic mistakes. Ascertaining the risks that new products, procedures, or policies present before they are produced or implemented protects not only current generations but future generations from low risk, high consequence surprises like climate change driven slowing of the ocean's thermohaline conveyor system, truly an unwelcome climate surprise.

Ecological economics offers an evolutionary, holistic approach to rectifying this worldwide threat. Global climate change is undoubtedly a dynamic, multi-dimensional process that is influencing a variety of human and natural processes and systems now and will probably continue to do so for the foreseeable future. Ecological economists understand that the resulting changes in these processes and systems must be researched, comprehended, and incorporated into a master plan for mitigation and adaptation. Also, a paradigm that recognizes the magnitude of the whole climate change problem and the interdependence of the political, social, economic, and environmental parts is much better suited to counter global warming than an approach that focuses only on the economic dimensions.

The master ecological economic plan to counter this threat could be based on democratic principles that encourage creation of a legitimate, transparent, inclusive, and

effective climate change regime. In particular, democratic processes can more effectively integrate the quantitative and qualitative features of climate change consequences. Democratic ecological economic processes can also more effectively support and enable debate on and assimilation of the diverse values, needs, and prejudices of global society as the world's citizens attempt to find an answer to this quandary. The subjective concerns for equity and fairness during climate change deliberations are a potent force during negotiations and only ecological economics recognizes the salience, pervasiveness, and power of equity issues. Again, the ecological economic paradigm explains, describes, and prescribes climate change events much more fully and completely than the neo-classical economic paradigm.

Paradigm Change – Modern Liberal Economic Ecology

The far-reaching and wide-scale effects of global climate change may impact the dominant political, social, and economic paradigms. The net result may be the evolution of a new comprehensive ecological theory that integrates political, social, and economic factors. The new paradigm could have unique and blended features from the liberal, ecological modernization, and ecological economic camps. The main agents, core concepts, core processes, and the main emphasis of the new theory may be a synthesis of the previous three paradigms and could be labeled “Liberal Economic Ecology” theory (See Table 7). In relation, ecology can be defined as the relationships between human groups and their physical and social environments and as such the definition is broad enough to incorporate political, social, economic, and environmental relationships and studies.

The primary agents of liberal economic ecology are the stakeholders in the communities affected. Any group or individual, local, regional, or global that has an interest in the interactions between humans and their environment would be a stakeholder. Also, liberal economic ecology would be based on the core concepts and assumptions found in liberalism, ecological modernization, and ecological economics. In addition, the labors to reconcile the economic and environmental sphere which often involve the processes that affect the freedom, well-being, and progress of human populations and their interaction with efforts to maintain the sustainable health of natural ecosystems could be a main focus of liberal economic ecology. The core processes for reintegrating humanity and nature may, as mentioned before, involve Kantian forces.

Democracy could be the driving political ideology, providing pluralistic consent, openness, inclusiveness, and legitimacy. International organizations would be the framework and foundation for efforts to democratically institutionalize reconciliation between man and nature. Specifically, free trade and the market could be the economic vehicles used to transform, improve, and diffuse policies and programs that would maintain indefinitely natural and human-made capital. Importantly, only through equitable, effective, and efficient application of the Kantian forces can global climate change be eventually countered. All of the actors, concepts, and processes are aligned to preserving the freedom, economic well-being, progress, and equity of natural ecosystems and human civilization using sustainable global development as the overall guiding principle (See Table 7).

Table 7. Core Assumptions of Liberal Economic Ecology

Characteristics	Liberal Economic Ecology
Agents	Stakeholders and Communities
Core Concepts	Liberalism, Ecological Modernization, and Ecological Economics
Core Processes	Kantian Forces, Reintegration of Economics and Ecology
Main Emphasis	Freedom, Economic Well-being, Progress, Equity, and Sustainable Development

The formula for this political, social, economic, and environmental transformation is as follows. Global climate change would be a catalyst for a change in equilibrium between the realist and liberal worldview, between the dominant social paradigm and the new environmental paradigm, and between neo-classical economics and ecological economics. After the paradigm changes a new equilibrium may be established based on a synthesis of the paradigm change winners, liberalism, ecological modernization, and ecological economics, perhaps described as liberal economic ecology. In conclusion, global climate is one of the most powerful political, social, economic, and environmental forces that man has ever encountered and could potentially catalyze profound global changes in one form or another.

Recommendations – Introduction

The potential paths to mitigating global climate change are numerous and can be complex. Nevertheless, some proposals have arisen that embody the major principals of the paradigms hypothesized to assume dominance as a result of global warming. Accordingly, the proposals encapsulate many of the core assumptions of a liberal economic ecology paradigm and exemplify the potential of this new approach to

accurately and fully explain, describe, and prescribe international relations and global environmental change challenges.

Many researchers have concluded that mitigation and adaptation efforts present an enormous opportunity of various dimensions and one opportunity could be to save money (Hawken, Lovins, and Lovins 1999; Berger 2002; Bernow et al. 2002). Specifically, some scientists have asserted that the US could “dramatically reduce greenhouse gas (GHG) emissions over the next two decades while the economy continues to grow” (Bernow et al. 2002, 189). In general, many cost effective proposals to mitigate or adapt to global warming are based on policies that would increase energy efficiency, promote renewable energy technologies, assist developing states, and drive a global shift to low-carbon or carbon-free fuels (Bernow et al. 2002).

Recommendation – Energy Conservation

The elimination of the wasteful use of energy resources alone could be a potent force in countering climate change and notably, it is usually cheaper to save energy than to purchase it, regardless of source. For example, during the period from 1979-1986 the US economy grew 19%, yet the total use of energy decreased by 6 percent. Furthermore, even though the amount of energy used to make a given product has been decreasing by roughly one or two percent per year, a tremendous range of opportunities still exists to further reduce energy use (Hawken, Lovins, and Lovins 1999).

It is estimated that Americans alone could save over \$300 billion a year in energy bills using existing energy conservation technologies (Hawken, Lovins, and Lovins 1999). In general, improving the energy-efficiency in buildings and industry

can reduce consumer costs, the need for more electric power plants, and reduce greenhouse gas emissions overall. Also, new energy efficient gasoline-electric hybrid automobiles and light trucks decrease oil consumption, reduce air pollution, and substantially diminish greenhouse gas emissions (Smith et al. 2002). In particular, energy efficient heat pumps, household appliances, lighting systems, electric generators, natural gas water heaters, super insulated windows and doors, and fuel cells are all examples of on-the-shelf technologies that can quickly reduce energy consumption while simultaneously decreasing greenhouse gas emissions (Hawken, Lovins, and Lovins 1999; Jaffe, Newell, and Stavins 2001; Smith et al. 2002). Finally, updating the inefficient, fragile, and antiquated electric power system in the US alone would not only save energy and create jobs, but would also reduce emissions and enhance American security (Smith et al. 2002; Wirth, Gray, and Podesta 2003). Overall, new design methods, technologies, production controls/processes, and improvements to corporate cultures worldwide could reduce energy consumption rapidly and cost-effectively by increasing the efficient conversion, distribution, and use of energy (Hawken, Lovins, and Lovins 1999). Opportunities for energy conservation abound only global leadership is lacking.

Recommendation – Climate Friendly Technology

The burning of fossil fuels has many negative side effects in addition to being a primary cause of global warming. Ozone and acid aerosols (by-products of fossil fuel combustion) cause between \$2 and \$10 billion a year in damage to buildings, forests, and agriculture. Additionally, when costs of the harmful health effects of ozone and

acid aerosols are included the expenditures increase up to \$250 billion per year. These human and economic burdens alone from burning fossil fuels should be a compelling reason to pursue climate friendly technologies alone. However, the annual global costs of climate change in 2050 have been estimated to be over \$300 billion (Loucks 2002). Avoiding the considerable environmental, economic, and health costs produced by fossil fuel externalities would be an enormous boon to the global economy. Yet the transition from a fossil fuel energy based economy to a climate friendly energy based economy will probably be difficult and complicated (Loucks 2002).

The development and deployment of climate friendly technologies is a vital step toward diminishing the impacts of global climate change. This process involves both private and public partnerships led by aggressive and visionary political leaders. In particular, only a coalition of key stakeholders will have the political power to break the current unsustainable technological status quo and ultimately market forces that incorporate economic and ecological interests will be able to compel the social, political, and environmental changes needed to create a global climate friendly energy system (Wirth, Gray, and Podesta 2003). In the end, these forces must displace fossil fuels as the primary energy source for the future with alternative energy products and services.

The process to displace fossil fuels will probably require application of new, innovative, and diverse technologies. New technologies such as hybrid electric trains, clean diesels, hybrid gasoline-electric automobile engines, and mass-produced fuel cells are rapidly emerging (Smith et al. 2002; Wirth, Gray, and Podesta 2003). Additionally, renewable energy sources such as geothermal, biomass, wind power, and photovoltaics

(solar cells) are available and could provide at least half the world's energy over the next half-century (Hawken, Lovins, and Lovins 1999). For instance, wind power has become the world's fastest growing energy source and is already cost competitive with fossil fuel based energy generation (Loucks 2002).

Another illustration of currently available climate friendly technology is a small, off-the-shelf natural gas turbine that produces electricity and then reuses the waste heat for other services harnesses 90% to 91% of the fuel's energy content. Implementation of this one innovative technology, wherever practical, could reduce total carbon dioxide emissions in the US by approximately 23 percent (Hawken, Lovins, and Lovins 1999). Additionally, combined cycle gas turbine electric power plants with half the cost and one-fourth the carbon-intensity of coal-fired power plants are discreetly becoming the technology of choice for power generation around the world (Hawken, Lovins, and Lovins 1999). Overall, a gradual replacement of current carbon-intensive technologies with climate friendly technologies is well supported by many researchers as being a very prudent and cost-effective mitigation solution (Kolstad 1996; Wigley, Richels, and Edmonds 1996; Manne and Richels 1997; Toman 2001a; Smith et al. 2002).

Another source of climate friendly technologies are the new environmentally sound farming and forestry procedures being practiced in most developed states. Worldwide, the planting and harvesting of crops and the raising of livestock account for approximately 20% of global greenhouse gas emissions. In addition, tropical deforestation and land degradation produce 20% of the annual increase in carbon dioxide (Pearson 2002). Introduction of new climate friendly soil conservation and building processes, enhanced fertilizer management techniques, and sustainable forest

management procedures to developing states should improve agricultural/forest productivity, decrease greenhouse gas emissions, and increase the sequestration of carbon in the soil (Hawken, Lovins, and Lovins 1999; Niles 2002; Pearson 2002). Importantly, these new processes and techniques must be incorporated around the world if climate change is to be effectively mitigated. Consequently, the new technologies, processes, and techniques will probably need political, social, and economic support to increase their consumer and producer appeal and acceptance.

In particular, policies that create tax incentives for research and development of climate benign products and procedures must provide the producers enough regulatory flexibility so that the developers can build a consumer base without threatening the manufacturing base (Smith et al. 2002; Wirth, Gray, and Podesta 2003). Also, climate friendly technologies need additional research and development funding and consumers must be informed of the advantages and necessities of using green power and green products (Smith et al. 2002). A portent of the coming primacy of renewable technologies is the fact that all of the world's major oil companies are now major investors in climate friendly technologies (Hawken, Lovins, and Lovins 1999). Obviously, many modern firms have acknowledged the threat of climate change and are hedging for an uncertain future by investing in climate friendly technologies and more firms and states should be encouraged to follow suit.

Recommendation – Targeted Investment

The consequences of global climate change may spare no state and the world's poor could be the most direly affected by global warming. Around the world half of all

jobs depend on natural ecosystems like fisheries, forests, and agriculture, and many of these natural ecosystems could be significantly degraded by global warming (IPCC WG II, 2001; Wirth, Gray, and Podesta 2003). Closing the gap between rich and poor may become the most fruitful side effect of global efforts to mitigate climate change.

Several wise, equitable, and targeted investment strategies have been proposed that could help developing states counter climate change without mortgaging their future growth.

The target of some of these investment strategies would be the financial barriers developing countries encounter during the acquisition of climate friendly technology; barriers such as high transactions costs (a bane for small projects), high capital costs (in comparison to traditional, often inefficiently subsidized alternatives), and the inability to capture life-cycle cost savings from investments in renewable and climate friendly technologies (Wirth, Gray, and Podesta 2003). Additionally, market strategies that reduce risk and spur development and innovation of affordable climate friendly technologies are currently being tested and implemented (Aldy, Barron, and Tubiana 2003). The consensus of many studies is that transfers of both technology and capital would be very cost effective avenues for helping developing states mitigate climate change and would also allow developing countries to accomplish their development priorities on time or sooner than planned (Blackman 2001; Toman 2001; Agarwal 2002; Baer 2002; Heller and Shukla 2003). An unfortunate, yet in this instance potentially positive reality is that the developing states can move quickly and directly to low-cost, climate friendly energy economies with assistance from developed states because in the past they have been unable to afford the large capital investments in expansive fossil

fuel based energy systems that currently hamper the transition to climate friendly energy economies in the developed states (Loucks 2002). Finally, investments in developing countries open up new export opportunities for developed states and could boost international trade (Wirth, Gray, and Podesta 2003). However, an institution that can fairly distribute from rich countries to poor countries the financial contributions that will can be used to fund energy-efficient and climate friendly technologies for use in the developing world is still sorely needed (Wiener 2001; Schelling 2002). Furthermore, an establishment that would rationalize energy prices, improve availability of technological information, and improve energy infrastructures in developing states would speed the diffusion of climate friendly technology immensely (Blackman 2001). The key to targeted investments is to connect the development priorities of developing states to climate-favoring activities financed or assisted by the developed states (Heller and Shukla 2003). On the whole, a comprehensive strategy that would create such an institution and give poor people around the world access to modern, climate benign technology either through financial transfers or through technological diffusion can be developed within the framework of the Kyoto Protocol (Toman 2001).

Recommendation – Emissions Trading

The power and genius of private enterprise could turn the climate change dilemma into a business opportunity, locally and globally. Using the legitimacy of democratic governments through international organizations focused on free trade, a market can be created that could reward the economically efficient use of fuel and materials and produce substantial reduction in global greenhouse gas emissions.

Numerous studies conclude that the costs of reducing greenhouse gas emissions would be unequivocally lower if global trade in emissions is initiated (Petsonk, Dudek, and Goffman 1998; Edmonds et al. 1999; Toman 2001a; Wiener 2001; Baer 2002; Aldy, Barron, and Tubiana 2003). Specifically, over two-dozen regional markets have already been created that deal in carbon emission reductions and sequestrations (Hawken, Lovins, and Lovins 1999).

All parties to an international greenhouse gas emission market would benefit from trade, both emission allowance buyers and allowance sellers. Mitigations costs would also be reduced if the traders are given great flexibility in determining trading mechanisms and as many states as possible are encouraged to participate. Normally, the larger the market the lower the costs of operation. Nevertheless, a structure must still be constructed that assures the potential gains from trade are obtained (Edmonds et al. 1999). Essentially what is needed is an market-centered international regime that can ensure fair and accurate measurement of emission reductions, is transparent in its operations, provides fungibility in emissions trading, consistently applies all rules and regulations, and can effectively hold all participants accountable to regime goals (Petsonk, Dudek, and Goffman 1998; Edmonds et al. 1999; Toman 2001a). A regime of this type should be based on the exceptional progress already made by the signatories of the Kyoto Protocol.

Recommendations – Conclusions

Global climate change may require the aggressive conservation of energy resources until climate friendly technologies are developed and fielded. In addition, this

transition period will probably require collective action by numerous stakeholders that must be focused on integrating ecological concerns, economic priorities, and liberal mandates toward climate change and sustainable development goals. The underlying negotiations will probably require application of democratic procedures, utilizing international organizations to apply free market mechanisms, and the free market mechanisms should be built around international trade in greenhouse gas emission allowances. Global participation in emission trading is mandatory for success.

Additionally, success can only be ensured by an equitable, targeted investment strategy that enables developing states to receive adequate financial and technological transfers from developed states that should ensure developed states can effectively and efficiently mitigate climate change without sacrificing development and sustainability priorities.

In summation:

A proper understanding of the practical engineering economics of energy efficiency, and of other climate-stabilizing opportunities, can thus give nearly all the parties to the climate debate what they want. Those who worry about climate can see the threats to it ameliorated. Those who don't can still make money. Those who worry about the costs and burdens of redesigning their businesses will see those investments rewarded. Those who want improved jobs, competitiveness, quality of life, public and environmental health, and individual choice and liberty can get those things, too. By emphasizing energy efficiency, and climate-protecting grazing, farming, and forestry practices based on natural systems, we can responsibly and profitably address not only climate but about 90 percent of EPA's pollution and public-health concerns--smog and particulate emissions, toxic emissions, runoff from agrochemicals, and many more. These actions are vital to a vigorous economy, national security, a healthful environment, sustainable development, social justice, and a livable world. (Hawken, Lovins, and Lovins 1999, 256-257).

WORKS CITED

- Adams, Richard M., Brian H. Hurd, and John Reilly. 1999. *Agriculture and Global Climate Change: A Review of Impacts to U.S. Agricultural Resources*. February. Arlington, VA.: Pew Center on Global Climate Change.
- Agarwal, Anil. 2002. "A Southern Perspective on Curbing Global Climate Change." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Agrawala, Shardul, and Steinar Andresen. 1999. "Indispensability and Indefensibility? The United States in the Climate Treaty Negotiations." *Global Governance* 5, no. 4 (October-December): 457-482.
- Aharon, Paul. 2003. "Meltwater Flooding Events in the Gulf of Mexico Revisited: Implications for Rapid Climate Changes During the Last Deglaciation." *Paleoceanography* 18, no. 4; 1079-1092.
- Aldy, Joseph E., John Ashton, Richard Baron, Daniel Bodansky, Steve Charnovitz, Elliot Diringer, Thomas C. Heller, Jonathan Pershing, P.R. Skula, Laurence Tibiana, Fernando Tudela, and Xueman Wang. 2003. *Beyond Kyoto: Advancing the International Effort Against Climate Change*. December. Arlington VA.: Pew Center on Global Climate Change.
- Aldy, Joseph E., Richard Baron, and Laurence Tubiana. 2003. "Addressing Cost: The Political Economy of Climate Change." In *Beyond Kyoto: Advancing the International Effort Against Climate Change*. Edited by Joseph E. Aldy et al. December. Arlington VA: Pew Center on Global Climate Change.
- Allen, L. H. Jr., K. J. Boote, J. W. Jones, P. H. Jones, R. R. Valle, B. Acock, H. H. Rogers, and R. C. Dahlman. 1987. "Response of Vegetation to Rising Carbon Dioxide: Photosynthesis, Biomass, and Seed Yield of Soybean." *Global Biochemical Cycles* 1: 1-14.
- Amin, Samir. 1977. *Imperialism and Uneven Development*. New York: Monthly Review Press.
- Anderson, D., and C. D. Bird. 1992. "Carbon Accumulation and Technical Progress—A Simulation Study of Costs." *Oxford Bulletin of Economics and Statistics* 54: 1-29.

- Anderson, J.W. 1999. "A Crash Course in Climate Change." In *The RFF Reader in Environmental and Resource Management*. Edited by W.E. Oates. Washington D.C.: Resources for the Future.
- Anderson, Kai S. 2002. "The Climate Policy Debate in the U.S. Congress." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider et al. Washington D.C.: Island Press.
- Anderson, Terry L., and Donald T. Leal. 1999. "Vision of the Environment and Rethinking the Way We Think." In *Debating the Earth: The Environmental Politics Reader*. Edited by John S. Dryzek and David Schlosberg. Oxford, U.K.: Oxford University Press.
- Anderson, Terry L., and Henry I. Miller, M.D., eds. 2000. *The Greening of U.S. Foreign Policy*. Stanford: Hoover Institution Press.
- Angell, Norman, Sir. 1913. *The Great Illusion: A Study of the Relation of Military Power to National Advantage*. New York: G. Putnam's Sons.
- Arrow, Kenneth. 1962. "The Economic Implications of Learning-by-Doing." *Review of Economic Studies* 29: 155-173.
- Arrow, Kenneth, Bert Bolin, Robert Costanza, Partha Dasgupta, Carl Folke, C. S. Holling, Bengt-Owe Jansson, Simon Levin, Karl-Goran Maller, Charles Perrings, and David Pimentel. 1995. "Economic Growth, Carrying Capacity, and the Environment." *Science* 268, (April):
- Ashton, John, and Xueman Wang. 2003. "Equity and Climate: In Principle and Practice." In *Beyond Kyoto: Advancing the International Effort Against Climate Change*. December. Arlington VA.: Pew Center on Global Climate Change.
- Axelrod, Robert, and Robert O. Keohane. 1985. "Achieving Cooperation Under Anarchy: Strategies and Institutions." *World Politics* 38 (October): 226-254.
- Baer, Paul. 2002. "Equity, Greenhouse Gas Emissions, and Global Common Resources." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, et al. Washington D.C.: Island Press.
- Baker, James. 1990. "Address to the National Governor's Association." Washington D.C.: 26 February.
- Baker, Susan. 1996. "The Scope for East-West Cooperation." In *Environmental Policy in an International Context: Prospects for Environmental Change*. Edited by A. Blowers and P. Glasbergen. New York: John Wiley.

- Bailey, Ronald. 1993. *Eco-Scam: The False Prophets of Ecological Apocalypse*. New York: St. Martin's Press.
- Balbus, John M., and Mark L. Wilson. 2000. *Human Health and Global Climate Change: A Review of Potential Impact in the United States*. December. Arlington, VA.: Pew Center on Global Climate Change
- Baldwin, David A., ed. 1993. *Neorealism and Neoliberalism: The Contemporary Debate*. New York: Columbia University Press.
- _____. 1993a. "Neoliberalism, Neorealism, and World Politics." In *Neorealism and Neoliberalism: The Contemporary Debate*. Edited by David A. Baldwin. New York: Columbia University Press.
- Beck, Ulrich. 1992. *Risk Society: Toward a New Modernity*. London: Sage.
- _____. 1995. *Ecological Politics in an Age of Risk*. Cambridge, MA: Polity Press.
- _____. 1996. "Risk Society and the Provident State." In *Risk, Environment, and Modernity: Towards a New Ecology*. Edited by Scott Lash, Bronislaw Szerszynski, and Brian Wynne. London: SAGE Publications.
- Beder, Sharon. 1998. *Global Spin: The Corporate Assault on Environmentalism*. Melbourne: Scribe Publications.
- Berger, John J. 2002. "Renewable Energy Sources as a Response to Global Climate Concerns." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Bernow, Stephen, Alison Bailie, William Dougherty, Sivan Kartha, and Michael Lazarus. 2002. "Carbon Abatement with Economic Growth: A National Strategy." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Bernstein, Mark, Scott Hassell, Jeff Hagen, et al., and RAND. 1999. *Developing Countries and Global Climate Change: Electric Power Option for Growth*. June. Arlington, VA.: Pew Center on Global Climate Change.
- Blackman, Allen. 2001. "The Economics of Climate-Friendly Technology Diffusion in Developing Countries." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- Blowers, Andrew. 1997. "Environmental Policy: Ecological Modernisation or Risk Society?" *Urban Studies* 34, no. 5-6: 845-871.

- Bodansky, Daniel. 2001. "The History of the Global Climate Change Regime." In *International Relations and Global Climate Change*. Edited by Urs Luterbacher and Detlef F. Sprinz. Cambridge, MA.: MIT Press.
- _____. 2001a. "International Law and the Design of a Climate Change Regime." In *International Relations and Global Climate Change*. Edited by Urs Luterbacher and Detlef F. Sprinz. Cambridge, MA.: MIT Press.
- Bridge, Gavin, and Phil McManus. 2000. "Sticks and Stones: Environmental Narratives and Discursive Regulation in Forestry and Mining Sectors." *Antipode* 32, no. 1: 10-47.
- Brown, Greg, and Charles Harris. 1992. "The USDA Forest Service: Toward the New Resource Management Paradigm." *Society and Natural Resources* 5: 231-245.
- Brown, Lester R., Christopher Flavin, and Hilary French, et al. 2000. *State of the World 2001*. New York: W.W. Norton & Company, The Worldwatch Institute.
- Brulle, Robert J. 2000. *Agency, Democracy, and Nature: The U.S. Environmental Movement from a Critical Theory Perspective*. Cambridge, MA.: MIT Press.
- Bueno de Mesquita, Bruce, and David Lalman. 1992. *War and Reason*. New Haven, CT.: Yale University Press.
- Bull, Hedley. 1977. *The Anarchical Society: A Study of Order in World Politics*. New York: Columbia University Press.
- Burtraw, Dallas, and Michael A. Toman. 2001. "'Ancillary Benefits' of Greenhouse Gas Mitigation Policies." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- Bush, George W. 2001. "Remarks by the President on Climate Change and Clean Air." Washington D.C.: Office of the Press Secretary. On-line. Internet, 14 February. Available from <http://usa.or.th/news/wf/ep416.htm>.
- _____. 2001a. "Text of a Letter from the President to Senators Hagel, Helms, Craig, and Roberts." Washington D.C.: Office of the Press Secretary. On-line. Internet, 13 March. Available from <http://www.whitehouse.gov/news/releases/2001/03/20010314.html>.
- _____. 2001b. "President Bush Discusses Global Climate Change." Washington D.C.: Office of the Press Secretary. On-line. Internet, 11 June. Available from <http://www.whitehouse.gov/news/releases/2001/03/20010611.html>.

- Buttel, Frederick H., and Craig R. Humphrey. 2002. "Sociological Theory and the Natural Environment." In *Handbook of Environmental Sociology*. Edited by E.E. Dunlap and W. Michelson. London: Greenwood Press.
- Cardoso, Fernando H., and Enzo Faletto. 1979. *Dependency and Development in Latin America*. Berkley, CA.: University of California Press.
- Carr, E. H. 1939. *The Twenty-Years' Crisis, 1919-1939: An Introduction to the Study of International Relations*. New York: Harper & Row Torchbooks.
- Catton, William R. Jr., and Riley E. Dunlap. 1978. "Environmental Sociology: A New Paradigm." *The American Sociologist* 13.
- Cazorla, Marina V., and Michael A. Toman. 2001. "International Equity and Climate Change Policy." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- Clarke, Garry, David Leverington, James Teller, and Arthur Dyke. 2003. *Science* Vol. 301, no. 5635: 922-923.
- Claude, Inis L. 1962. *Power and International Relations*. New York: Random House.
- Claussen, Eileen, and Lisa McNeilly. 2000. *Equity and Global Climate Change: The Complex Elements of Global Fairness*. June. Arlington, VA.: Pew Center on Global Climate Change.
- Claussen, Eileen, and Vicki A. Cochran. 2000. *Climate Change: Science, Strategies, and Solutions*. Facts and Figures Chapter, Pew Center on Global Climate Change. On-line. Internet, XXXXX. Available from <http://www.pewclimate.org/book/ff chapter.pdf>.
- Coase, Ronald H. 1960. "The Problem of Social Cost." *Journal of Law and Economics* 3: 1-44.
- Costanza, Robert. 2001. "Visions, Values, Valuation, and the Need for an Ecological Economics." *BioScience* 51, no. 6: 459-458.
- Costanza, Robert, and Lisa Wainger. 1991. "Ecological Economics." *Business Economics* 26, no. 4, (October): 45-48.
- Costanza, Robert, Herman Daly, Carl Folke, Paul Hawken, C. S. Holling, Anthony J. McMichael, David Pimentel, and David Rapport. 2000. "Managing Our Environmental Portfolio." *BioScience* 50, no. 2: 149-155.

- Costanza, Robert, John Cumberland, Herman Daly, Robert Goodland, and Richard Norgaard. 1997. *An Introduction to Ecological Economics*. Boca Raton, FL.: St. Lucie Press.
- Council on Environmental Law (CIEL). 1991. *The Precautionary Principle: A Policy for Action in the Face of Uncertainty*. London: King's College.
- Crosby, Alfred. 1986. *Ecological Imperialism: The Biological Expansion of Europe, 900-1900*. Cambridge, U.K.: Cambridge University Press.
- Crosson, Pierre. 2001. "Agriculture and Climate Change." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- Crowley, Kate. 1999. "Jobs and Environment: The 'Double Dividend' of Ecological Modernisation?" *International Journal of Social Economics* 26, no. 7/8/9: 1013-1026.
- Cure, J.D., and B. Acock. 1986. "Crop Responses to Carbon Dioxide Doubling: A Literature Survey." *Agriculture and Forest Meteorology* 38: 127-145.
- Curran, Giorel. 2001. "The Third Way and Ecological Modernization." *Contemporary Politics* 7, no. 1: 41-55.
- Dabelko, Geoffrey D., and David D. Dabelko. 1995. "Environmental Security: Issues of Conflict and Redefinition." *Environmental Change and Security Project Report*. (spring).
- Daly, Herman E. 1993. "Steady-State Economics: A New Paradigm." *New Literary History* 24, no. 4: 811-816.
- Dannenmaier, Eric, and Isaac Cohen. 2000. *Promoting Meaningful Compliance with Climate Change Commitments*. November. Arlington, VA.: Pew Center on Global Climate Change.
- Darmstadter, Joel. 2001. "The Role of Renewable Resources in U.S. Electricity Generation: Experience and Prospects." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- Dasgupta, Partha, Simon Levin, and Jane Lubchenco. 2000. "Economic Pathways to Ecological Sustainability." *BioScience* 50, no. 4: 339-345.

- DeCanio, Stephen J. 2000. "The Organizational Structure of Firms and Economic Models of Climate Policy." In *New Directions in the Economics and Integrated Assessment of Global Climate Change*. October. Arlington, VA.: Pew Center on Global Climate Change.
- DeCanio, Stephen J., Richard B. Howarth, Alan H. Sanstad, Stephen H. Schneider, and Starley L. Thompson. 2000. *New Directions in the Economics and Integrated Assessment of Global Climate Change*. October. Arlington, VA.: Pew Center on Global Climate Change.
- Deudney, Daniel H. 1999. "Bringing Nature Back In: Geopolitical Theory from the Greeks to the Global Era." In *Contested Grounds: Security and Conflict in the New Environmental Politics*. Edited by D.H. Deudney and R.A. Matthew. Albany, N.Y.: SUNY Press.
- _____. 1999a. "Environmental Security: A Critique." In *Contested Grounds: Security and Conflict in the New Environmental Politics*. Edited by D.H. Deudney and R.A. Matthew. Albany, N.Y.: SUNY Press.
- Deudney, Daniel H., and Richard A. Matthew, eds. 1999. *Contested Grounds: Security And Conflict in the New Environmental Politics*. Albany, N.Y.: SUNY Press.
- Diamond, Jared. 1999. *Guns, Germs, and Steel: The Fates of Human Societies*. New York: W.W. Norton & Company.
- Diehl, Paul R., and Niles Petter Gleditsch, eds. 2001. *Environmental Conflict*. Boulder CO.: Westview Press.
- Dos Santos, Theotonio. 1970. "The Structure of Dependence." *The American Economic Review* 60, (May): 231-236.
- Dougherty, James E., and Robert L. Pfaltzgraff, Jr. 2001. *Contending Theories of International Relations: A Comprehensive Survey*, 5th ed. New York: Longman.
- Doyle, Michael W. 1986. "Liberalism and World Politics." *The American Political Science Review* 80, no.4, (December): 1151-1169.
- _____. "Liberalism and World Politics Revisited." In *Controversies in International Relations Theory: Realism and the Neoliberal Challenge*. Edited by Charles W. Kegley Jr. New York: St. Martin's Press.
- Duffie, Darrel, and Hugo Sonnenschein. 1989. "Arrow and General Equilibrium Theory." *Journal of Economic Literature* 27, no. 2, (June): 565-599.

- Dunlap, Riley E., and Angela G. Mertig. 1997. "Global Environmental Concern: An Anomaly for Postmaterialism." *Social Science Quarterly* 78, no. 1, (March): 24-29.
- Dunlap, Riley E., George Gallup Jr., and Alec Gallup. 1993. "Of Global Concern: Results of the Health of the Planet Survey." *Environment* 35, 1993: 6-15, 33-39.
- Dunlap, Riley E., and Kent Van Liere. 1978. "The New Environmental Paradigm: A Proposed Measuring Instrument and Preliminary Results." *Journal of Environmental Education* 9: 10-19.
- _____. 1984. "Commitment to the Dominant Social Paradigm and Concern for Environmental Quality." *Social Science Quarterly* 65: 1013-1028.
- Dunlap, Riley E., and William R. Catton, Jr. 1994. "Struggling With Human Exemptionalism: The Rise, Decline, and Revitalization of Environmental Sociology." *Social Science Quarterly* 78, no. 1, (March): 503-9.
- Dunlap, Riley E., Chenyang Xiao, and Aaron M. McCright. 2001. "Politics and Environment in America: Partisan and Ideological Cleavages in Public Support for Environmentalism." *Environmental Politics* 10, no. 4: 23-48.
- Dyer, Hugh. 2001. "The Environment in International Relations." *British Journal of Politics and International Relations* 3, no. 1, (April): 105-114.
- EDGAR (Electronic Data Gathering Analysis Retrieval). 2000. Dutch National Institute of Public Health and the Environment. *Emissions Database for Global Atmospheric Research*. On-line. Internet, 17 April. Available from <http://www.rivm.nl/env/int/coredate>.
- Edmonds, Jae, Joseph M. Roop, and Michael J. Scott. 2000. *Technology and The Economics of Climate Change Policy*. September. Arlington, VA.: Pew Center on Global Climate Change.
- Edmonds, Jae, Michael J. Scott, Joseph M. Roop, and Christopher N. MacCracken. 1999. *International Emissions Trading and Global Climate Change: Impacts of the Costs of Greenhouse Gas Mitigation*. December. Arlington, VA: Pew Center on Global Climate Change.
- Ehrlich, Paul R. 1968. *The Population Bomb*. New York: Sierra Club-Ballantine.
- Environmental Sustainability Index (ESI). 2000. "An Initiative of the Global Leaders of Tomorrow Environment Task Force, World Economic Forum; Annual Meeting 2002." Yale Center for Environmental Law and Policy. On-line. Internet. Available from <http://www.ciesin.columbia.edu/indicators/ESI>.

- Ferguson, Yale H., and R. W. Mansbach. 1988. *The Elusive Quest: Theory and International Politics*. Columbia, S.C.: University of South Carolina Press.
- Feshbach, Murray. 1995. *Ecological Disaster: Cleaning Up the Hidden Legacy of the Soviet Regime*. New York: The Twentieth Century Fund Press.
- Feshbach, Murray, and Alfred Friendly Jr. 1992. *Ecoside in the USSR: Health and Nature Under Siege*. New York: Basic Books.
- Fischer, Carolyn, Suzi Kerr, and Michael A. Toman. 2001. "Using Emission Trading To Regulate National Greenhouse Gas Emissions." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- Ford, William C. 2000. "Speech: William Clay Ford, Jr., The 5th Annual Greenpeace Business Conference." London. On-line. Internet, October 5. Available from http://media.ford.com/article_display.cfm?article_id=6217.
- Foster, Gregory D. 2001. "Environmental Security: The Search for Strategic Legitimacy." *Armed Forces and Society* 27, no. 3, (Spring): 373-395.
- Foster, John Bellamy. 1997. "The Crisis of the Earth: Marx's Theory of Ecological Sustainability as a Nature-Imposed Necessity for Human Production." *Organization and Environment* 10, no. 3: 278-295.
- _____. 1999. "Marx's Theory of Metabolic Rift: Classical Foundation for Environmental Sociology." *American Journal of Sociology* 105, no. 2: 366-405.
- _____. 2000. *Marx's Ecology: Materialism and Nature*. New York, NY: Monthly Review Press.
- Frederick, Kenneth D., and Peter H. Gleick. 1999. *Water and Global Climate Change: Potential Impacts on U.S. Water Resources*. September. Arlington, VA.: Pew Center on Global Climate Change.
- Freeman, A. M. 1993. *The Measurement of Environmental and Resource Values: Theory and Methods*. Baltimore, MD: Resources for the Future.
- Frieden, Jeffry A., and David A. Lake. 1996. "International Politics and International Economics." In *International Political Economy: State-Market Relations in the Changing Global Order*. Edited by C. Roe Goddard, John T. Passé-Smith, and John G. Conklin. Boulder, CO.: Lynne Rienner Publishers.
- Gaddis, John L. 1992-1993. "International Relations Theory and the End of the Cold War." *International Security* 17, no. 3, (Winter): 5-58.

- Gibbs, David. 2003. "Reconciling Economic Development and the Environment." *Local Environment* 8, no. 1: 3-8.
- Giddens, Anthony. 1991. *The Consequences of Modernity*. Stanford: Stanford University Press.
- _____. 1994. *Beyond Left and Right: The Future of Radical Politics*. Stanford: Stanford University Press.
- _____. 2000 [1999]. *Runaway World*. New York, NY: Routledge.
- Gilpin, Robert. 1975. *U.S. Power and the Multinational Corporation: The Political Economy of Direct Foreign Investment*. New York: Basic Books.
- _____. 1981. *War and Change in World Politics*. Cambridge: Cambridge University Press.
- _____. 1987. *The Political Economy of International Relations*. Princeton: Princeton University Press.
- Gleditsch, Nils Petter. 1997. "Environmental Conflict and the Democratic Peace." In *Conflict and the Environment*. Edited by Nils Petter Gleditsch. The Hague: Kluwer Academic.
- Goddard, C. Roe, John T. Passé-Smith, and John G. Conklin, eds. 1996. *International Political Economy: State-Market Relations in the Changing Global Order*. Boulder, CO.: Lynne Rienner Publishers.
- Goldfrank, Walter L., David Goodman, and Andrew Szasz. 1999. *Ecology and the World-System*. Edited by Walter L. Goldfrank, David Goodman, and Andrew Szasz. London: Greenwood Press.
- Goldstein, Joshua S. 2003. *International Relations*. 5th ed. New York: Longman Press.
- Goulder, Lawrence H., and Brian M. Nadreau. 2002. "International Approaches to Reducing Greenhouse Gas Emissions." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Goulder, Lawrence H., and Stephen H. Schneider. 1999. "Induced Technological Change and the Attractiveness of CO₂ Abatement Policies." *Resources and Energy Economics* 21, no. 3-4, (August): 211-252.

- Greenwald, Judith M., Brandon Roberts, and Andrew D. Reamer. 2001. *Community Adjustment to Climate Change Policy*. December. Arlington, VA: Pew Center on Global Climate Change.
- Grieco, Joseph M. 1988. "Anarchy and the Limits of Cooperation: A Realist Critique of the Newest Liberal Institutionalism." *International Organization* 42, no. 3: 485-507.
- Grossman, Gene, and Alan Krueger. 1995. "Economic Growth and the Environment," *Quarterly Journal of Economics* 110: 353-377.
- Grubb, Michael. 2000. "Economic Dimensions of Technological and Global Responses to the Kyoto Protocol." *Journal of Economic Studies* 27, no. 1-2: 111-125.
- Grubb, Michael, T. Chapuis, and M. Ha-Duong. 1995. "The Economics of Changing Course: Implications of Adaptability and Inertia for Optimal Climate Policy." *Energy Policy* 23, no. 4-5, (April/May): 417-432.
- Grundig, Frank, Hugh Ward, and Ethan R. Zorick. 2001. "Modeling Global Climate Negotiations." In *International Relations and Global Climate Change*. Edited by Urs Luterbacher and Detlef F. Sprinz. Cambridge, MA.: MIT Press.
- Gupta, Joyeeta. 2001. *Our Simmering Planet: What to do about Global Warming?* New York: Zed Books.
- Haas, Ernst B. 1953. "The Balance of Power: Prescription, Concept, or Propaganda." *World Politics* 5, no. 4 (July): 442-477.
- _____. 1958. *The Uniting of Europe: Political, Economic, and Social Forces, 1950-1957*. Stanford: Stanford University Press.
- _____. 1964. *Beyond the Nation-State*. Stanford, CA.: Stanford University Press
- Haas, Peter M., ed. 1992. *Knowledge, Power, and International Policy Coordination*. Special Issue of *International Organization* 46, no. 1.
- Hahn, R. W., and R. N. Stavins. 1999. "What Has Kyoto Wrought? The Real Architecture of International Tradable Permit Market." *EPRI Global Climate Change Research Seminar*. September. Columbus, OH: 27-29.
- Hajer, Maarten A. 1996. "Ecological Modernisation as Cultural Politics." In *Risk, Environment, and Modernity: Towards a New Ecology*. Edited by Scott Lash, Bronislaw Szerszynski, and Brian Wynne. London: SAGE Publications.
- Hawken, Paul, Amory Lovins, and L. Hunter Lovins. 1999. *Natural Capitalism*. New York: Little, Brown and Company.

- Hayek, Friedrich A. 1960. *The Road to Serfdom*. Chicago, IL: University of Chicago Press.
- Heller, Thomas C., and P. R. Shukla. 2003. "Development and Climate: Engaging Developing Countries." In *Beyond Kyoto: Advancing the International Effort Against Climate Change*. December. Arlington VA: Pew Center on Global Climate Change.
- Hertsgaard, Mark. 1998. *Earth Odyssey: Around the World in Search of Our Environmental Future*. New York: Broadway Books.
- Hoffman, Stanley. 1965. *The State of War: Essays in the Theory and Practice of International Politics*. New York: Praeger.
- Holden, Barry. 2002. *Democracy and Global Warming*. London: Continuum.
- Holsti, K. J. 1985. *The Dividing Discipline: Hegemony and Diversity in International Theory*. Boston: Allen and Unwin.
- Holsti, Ole R. 1995. "Theories of International Relations and Foreign Policy: Realism and It's Challengers." In *Controversies in International Relations Theory: Realism and the Neoliberal Challenge*. Edited by Charles W. Kegley Jr. New York: St. Martin's Press.
- Homer-Dixon, Thomas F. 1999. *Environment, Scarcity, and Violence*. Princeton: Princeton University Press.
- Houghton, John. 1997. *Global Warming: The Complete Briefing*. 2nd ed. Cambridge, U.K.: Cambridge University Press.
- Howarth, Richard B. 2000. "Climate Change and Intergenerational Fairness." In *New Directions in the Economics and Integrated Assessment of Global Climate Change*. October. Arlington, VA.: Pew Center on Global Climate Change.
- Huber, Joseph. 1982. *Die Verlorene Unschuld der Ökologie: Neue Technologien und Superindustrielle Entwicklung*. Fisher Verlag: Frankfurt am Main.
- Hughes, Barry B. 1997. *Continuity and Change in World Politics: Competing Perspectives*. 3rd ed. Upper Saddle River, N.J.: Prentice-Hall.
- Humphrey, Craig R., Tammy L. Lewis, and Frederick H. Buttel. 2002. *Environment, Energy, and Society: A New Synthesis*. Belmont C.A.: Wadsworth.

Inglehart, Ronald. 1995. "Public Support for Environmental Protection: Objective Problems and Subjective Values in 43 Societies." *PS: Political Science and Politics* 28, no.1 (March): 57-72.

_____. 2000. "Globalization and Postmodern Values." *The Washington Quarterly* 23, no. 1, (winter): 215-228.

Intergovernmental Panel on Climate Change (IPCC). 1998. *Principles Governing IPCC Work*. On-line. Internet, 1 October. Available from <http://www.ipcc.ch/about/princ.pdf>

Intergovernmental Panel on Climate Change (IPCC WG I). 2001. A Report of Working Group I, *Climate Change 2001: The Scientific Basis - Summary for Policymakers*. Cambridge U.K.: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC WG II). 2001. A Report of Working Group II, *Summary for Policymakers-Climate Change 2001: Impacts, Adaptation, and Vulnerability*. Cambridge U.K.: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC WG III). 2001. A Report of Working Group III, *Summary for Policymakers: Climate Change 2001: Mitigation*. Cambridge U.K.: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC Press Release). 2001. "Press Advisory: New Report to Assess Options for Cutting Greenhouse gas emissions." On-line. Internet, 23 February. Available from <http://www.ipcc.ch/present/pr28-3.htm>.

International Energy Agency (IEA). 2000. *CO2 Emissions from Fossil Fuel Combustion, 1971-1997, 1999 Edition*. Organization for Economic Co-operation and Development/IEA. Paris, France.

Jaffe, Adam B., Richard G. Newell, and Robert N. Stavins. 2001. "Energy-Efficient Technologies and Climate Change Policies: Issues and Evidence." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.

Jancar-Webster, Barbara. 1993. "Eastern Europe and the Former Soviet Union." In *Environmental Politics and Policy in the International Arena: Movements, Parties, Organizations, and Policy*. Edited by S. Kamieniecki. Albany, N.Y.: SUNY.

Janicke, Martin. 1986. *Staatsversagen: Die Ohnmacht der Politik in der Industriegesellschaft*. Munchen: Piper

Jervis, Robert. 1978. "Cooperation Under the Security Dilemma." *World Politics* 30: 317-349.

- Johannessen, O. M., E. V. Shalina, and M. W. Miles. 1999. "Satellite Evidence for an Arctic Sea Ice Cover in Transformation." *Science* 286: 1937-1939.
- Jones, Laura. 1997. *Global Warming: The Science and the Politics*. Vancouver: The Fraser Institute.
- Kamarck, Andrew M. 1976. *The Tropics and Economic Development: A Provocative Inquiry into the Poverty of Nations*. Baltimore, MD: Johns Hopkins University Press.
- Kant, Emmanuel. [1781-1795] 2001. *Basic Writings of Kant*. Edited and with an introduction by Allen W. Wood. New York: Random House.
- Kates, Robert W. 1994. "Redefining Security." *Environment* 36, no. 3, (April): 1.
- Katzenstein, Peter J., Robert O. Keohane, and Stephen D. Krasner. 1998. "International Organization and the Study of World Politics." *International Organization* 52, no. 4, (Autumn): 645-685.
- Kegley, Charles W. Jr. 1993. "The Neorealist Moment in International Studies? Realist Myths and the New International Realities." *International Studies Quarterly* 37: 131-146.
- Kegley, Charles W. Jr., ed. 1995. *Controversies in International Relations Theory: Realism and the Neoliberal Challenge*. New York: St. Martin's Press.
- Keohane, Robert O. 1984. *After Hegemony: Cooperation and Discord in the World Political Economy*. Princeton, NJ: Princeton University Press.
- _____. 1989. *International Institutions and State Power: Essays in International Relations*. Boulder, CO.: Westview Press.
- _____. 1989a. "International Liberalism Reconsidered." In *The Economic Limits of Politics*. Edited by John Dunn. Cambridge: Cambridge University Press.
- Keohane, Robert O., and Joseph Nye. 1972. "Introduction and Conclusion." In *Transnational Relations and World Politics*. Edited by Robert Keohane and Joseph Nye. Cambridge, MA.: Harvard University Press.
- _____. 1977. *Power and Interdependence: World Politics In Transition*. Boston: Little Brown.
- Keohane, Robert O., Marc A. Levy, and Peter M. Haas. 1993. *Institutions for the Earth: Sources of Effective Environmental Protection*. Boston: MIT Press.

- Kerr, Suzi. 2001. "Allocating Liability in International Greenhouse Gas Emission Trading and the Clean Development Mechanism." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- Kolstad, Charles D. 1996. "Learning and Stock Effects in Environmental Regulation: The Case of Greenhouse Gas Emissions." *Journal of Environmental Economics and Management* 31: 1-18.
- Krasner, Stephen D. 1976. "State Power and the Structure of International Trade." *World Politics* 28, no. 3 (April): 317-345.
- _____. 1978. *Defending the National Interest*. Princeton, N.J.: Princeton University Press.
- Krasner, Stephen D., ed. 1983. *International Regimes*. New York: Cornell University Press.
- Kronick, Charlie. 1999. "The International Politics of Climate Change." *The Ecologist* 29, no. 2 (March-April).
- Kuettling, Gabriella. 2000. *Environment, Society, and International Relations: Towards More Effective International Environmental Agreements*. London and New York: Routledge.
- Kuhn, Thomas. 1962. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.
- Lamb, H. H. 1982. *Climate, History, and the Modern World*. London: Methuen.
- Lash, Scott, Bronisław Szerszynski, and Brian Wynne. 1996. *Risk, Environment, and Modernity: Towards a New Ecology*. London: SAGE Publications.
- Lawton, John H., and Robert M. May, eds. 1995. *Extinction Rates*. Oxford, U.K.: Oxford University Press.
- Lee, H. 1995. *Shaping National Responses to Climate Change*. Washington D.C.: Island Press.
- Legro, Jeffrey W., and Andrew Moravcsik. 1999. "Is Anybody Still a Realist?" *International Security* 24, no. 2, (Fall): 5-55.

- Levy, Marc A., Robert O. Keohane, and Peter M. Haas. 1993. "Improving the Effectiveness of International Environmental Institutions." In *Institutions for the Earth: Sources of Effective International Environmental Protection*. Edited by P. M. Haas, R. O. Keohane, and M. A. Levy. Cambridge, MA.: MIT Press.
- Lipson, Charles. 1984. "International Cooperation in Security and Economic Affairs." *World Politics* 37 (October): 1-23.
- Lobao, Linda, and Gregory Hooks. 2003. "Public Employment, Welfare Transfers, and Economic Well-Being Across Local Populations: Does a Lean and Mean Government Benefit the Masses?" *Social Forces* 82, no. 2: 519-556.
- Locke, John. 1960. *Two Treatises of Government*. Cambridge: Cambridge University Press.
- Loucks, Orie L. 2002. "Business Capitalizing on Energy Transition Opportunities." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Lomborg, Bjorn. 2001. *The Skeptical Environmentalist: Measuring the Real State of the World*. Cambridge, U.K.: Cambridge University Press.
- Luterbacher, Urs, and Carla Norrlof. 2001. "The Organization of World Trade and the Climate Regime." In *International Relations and Global Climate Change*. Edited by Urs Luterbacher and Detlef F. Sprinz. Cambridge, MA.: MIT Press.
- Luterbacher, Urs, and Detlef F. Sprinz. 2001. *International Relations and Global Climate Change*. Cambridge, MA.: MIT Press.
- Ma, Xiaoying, and Leonard Ortolano. 2000. *Environmental Regulation in China: Institutions, Enforcements, and Compliance*. New York: Rowman & Littlefield Publishers.
- Malcolm, Jay R., and Louis F. Pitelka. 2000. *Ecosystems and Global Climate Change: A Review of Potential Impacts on U.S. Terrestrial Ecosystems and Biodiversity*. December. Arlington, VA.: Pew Center on Global Climate Change.
- Manne, Alan S., and Richard Richels. 1997. "On Stabilizing CO₂ Concentrations-Cost Effective Emission Reduction Strategies." *Environmental Modeling and Assessment* 2, no. 4: 251-265.
- Margolis, Robert M., and Daniel M. Kammen. 2002. "Energy R&D and Innovation: Challenges and Opportunities." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.

- Marx, Karl and Friederick Engels. 1848. *Manifesto of the Communist Party*..
- Masood, Ehsan, and Laura Garwin. 1998. "Costing the Earth: When Ecology Meets Economics." *Nature* 395, no. 6701, (October): 427-427.
- Matthew, Richard A. 1999. "Social Responses to Environmental Change." In *Environmental Change, Adaptation, and Security*. Edited by S. C. Longeran. NATO Science Partnership Sub-Series: 2: Environmental Security Vol. 65.
- Mazrui, Ali. 1986. *The Africans: A Triple Heritage*. Boston: Little, Brown.
- McCright, Aaron M., and Riley E. Dunlap. 2000. "Challenging Global Warming as a Social Problem: An Analysis of the Conservative Movement's Counter-Claims." *Social Problems* 47, no. 4: 499-522
- _____. 2003. "Defeating Kyoto: The Conservative Movement's Impact on U.S. Climate Change Policy." *Social Problems* 50, no. 3: 348-473.
- McKibbin, Warwick J., and Peter J. Wilcoxon. 2002. "Climate Change After Kyoto." *The Brookings Review* 20, no. 2, (Spring): 6-10.
- Meadows, Donella, et al. 1972. *The Limits of Growth*. New York: New American Library.
- Mearsheimer, John J. 1994-1995. "The False Promise of International Institutions." *International Security* 19, no. 3, (Winter): 5-49.
- _____. 2001. *The Tragedy of Great Power Politics*. New York: Norton.
- Meyerson, Frederick A. B. 2002. "Population and Climate Change." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider et al. Washington, D.C.: Island Press.
- Michaels, Patrick J., and Robert C. Balling, Jr. 2000. *The Satanic Gases: Clearing the Air About Global Warming*. Washington D.C.: Cato Institute.
- Milbrath, Lester. 1993. "The World is Relearning its Story About How the World Works." In *Environmental Politics and Policy in the International Arena*. Edited by S. Kamieniecki. Albany N.Y.: SUNY Press.
- Milner, Helen. 1991. "The Assumption of Anarchy in International Relation Theory: A Critique." *Review of International Studies* 17 (January): 67-85

- Mitchell, Ronald B. 2001. "Institutional Aspects of Implementation, Compliance, and Effectiveness." In *International Relations and Global Climate Change*. Edited by Urs Luterbacher and Detlef F. Sprinz. Cambridge, MA.: MIT Press.
- Mitchell, William C., and Randy T. Simmons. 1994. *Beyond Politics: Markets, Welfare, and the Failure of Bureaucracy*. Boulder, CO: Westview Press.
- Mitrany, David. [1943] 1966. *A Working Peace System*. Chicago: Quadrangle Press.
- Mol, Arthur P. J. 1996. "Ecological Modernisation and Institutional Reflexivity: Environmental Reform in the Late Modern Age." *Environmental Politics* 5, no. 2, (summer): 302-323.
- _____. 2002. "Ecological Modernization and the Global Economy." *Global Environmental Politics* 2, no. 2 (May): 92-115.
- Mol, Arthur P. J., and David A Sonnenfeld. 2000. "Ecological Modernization Around the World: An Introduction." *Environmental Politics* 9, no. 1 (spring): 3-14.
- Mol, Arthur P. J., and Gert Spaargaren. 2000. "Ecological Modernisation Theory in Debate: A Review." *Environmental Politics* 9, no. 1: 19-49.
- Moore, Thomas Gale. 1998. *Climate of Fear: Why We Shouldn't Worry About Global Warming*. Washington D.C.: CATO Institute.
- Moravcsik, Andrew. 1997. "Taking Preferences Seriously: A Liberal Theory of International Politics." *International Organization* 51, no. 4, (Autumn): 513-553.
- Morgenthau, Hans J. 1978. *Politics Among Nations*. 5th ed. New York: Alfred A. Knopf Press.
- Moss, Norman. 1991. *The Politics of Global Warming*. London Defence Studies 1990-1991, No. 9. Great Britain: Brassey's.
- Mulder, Peter, and Jeroen C. J. M. Van Den Bergh. 2001. "Evolutionary Economic Theories of Sustainable Development." *Growth and Change* 32, (Winter): 110-134.
- Muller, Frank G. 2001. "Environmental Economics and Ecological Economics: Antagonistic Approaches?" *International Journal of Environmental Studies* 58; 415-443.
- Myers, Norman. 1993. "Environmental Refugees in a Globally Warmed World." *BioScience* 43, no. 11: 752-760.

- _____. 1993a. "Population, Environment, and Development." *Environmental Conservation* 20, no. 3, (Autumn): 205-216.
- _____. 1993b. *Ultimate Security: The Environmental Basis of Political Stability*. New York: W.W. Norton and Company.
- National Assessment Synthesis Team (NAST). U.S. Global Change Research Program. 2000. *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change*. Cambridge U.K.: Cambridge University Press.
- National Research Council (NRC). Committee on Science, Engineering, and Public Policy. 1991. *Policy Implications of Greenhouse Warming: Scientific Assessment*. Washington D.C.: National Academy Press.
- National Research Council (NRC). 2001. "Climate Change Science: An Analysis of Some Key Questions." Washington D.C.: National Academy Press.
- Neumann, James E., Gary Yohe, and Robert Nicholls. 2000. *Sea-Level Rise and Global Climate Change: A Review of Impacts to U.S. Coasts*. February. Arlington, VA.: Pew Center on Global Climate Change.
- Newell, Richard, and William Pizer. 2001. *Discounting the benefits of Climate Change Mitigation: How Much do Uncertain Rates Increase Valuations?* December. Arlington, VA.: Pew Center on Global Climate Change.
- Nicholls, Robert J., and Nobou Mimura. 1998. "Regional Issues Raised by Sea-Level Rise and Their Policy Implications." *Climate Research* 11, no. 1: 5-18.
- Nikitina, Elena. 1994. "Environment and Security and National Instability: The Case of the Former Soviet Union." In *Science, Technology, and the Environment*. Edited by J. Fleming and H. Gemery. Akron, OH: The University of Akron Press.
- Niles, John O. 2002. "Tropical Forests and Climate Change." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider et al. Washington D.C.: Island Press.
- Nordhaus, William D. 1992. "An Optimal Transition Path for Controlling Greenhouse Gases." *Science* 258: 1315-1319.
- _____. 1994. *Managing the Global Commons: The Economics of the Greenhouse Effect*. Cambridge, MA: MIT Press.
- _____. 2001. "Global Warming Economics." *Science* 294, 9 November: 1283-1284.
- Nordstrom, Hakan, and Scott Vaughan. 1999. *Trade and Environment*. Geneva, Switzerland: World Trade Organization.

- Norgaard, Richard B. 1994. *Development Betrayed: The End of Progress and a Coevolutionary Revisioning of the Future*. London: Routledge.
- _____. 2000. "Ecological Economics." *Bioscience* Vol. 50, no. 4 (April): 291.
- Nye, Joseph S. Jr. 2003. *Understanding International Conflicts: An Introduction to Theory and History* 4th ed. New York: Longman..
- O'Connor, James. 1991. "On the Second Contradiction of Capitalism." *Capitalism, Nature, Socialism* 8, (October).
- _____. 1996. "The Second Contradiction of Capitalism." In *The Greening of Marxism*. Edited by Ted Benton. New York: Guilford Press.
- _____. 1998. *Natural Causes: Essays in Ecological Marxism*. New York: The Guilford Press.
- Okun, Arthur. 1975. *Equality and Efficiency: The Big Tradeoff*. Washington D.C.: Brookings Institution.
- Olson, Mancur. 1971. *The Logic of Collective Action: Public Goods and the Theory of Groups*. Cambridge, MA.: Harvard University Press.
- _____. 1993. "Dictatorship, Democracy, and Development," *American Political Science Review* 87, no. 3, (September): 567-576.
- Oneal, John R., and Bruce M. Russett. 1997. "The Classical Liberals Were Right: Democracy, Interdependence, and Conflict, 1950-1985." *International Studies Quarterly* 41: 267-294.
- _____. 2001. "Clear and Clean: The Fixed Effects of the Liberal Peace." *International Organization* 55, no. 2, (Spring): 469-485.
- Onuf, Nicholas G., and Thomas J. Johnson. 1995. "Peace in the Liberal World: Does Democracy Matter?" In *Controversies in International Relations Theory: Realism and the Neoliberal Challenge*. Edited by Charles W. Kegley Jr. New York: St. Martin's Press.
- O'Riordan, Timothy. 2001. "The Early Bush Presidency and Climate Change Politics." *Environment* 43, no. 5: 1.
- Packenham, Robert A. 1992. *The Dependency Movement: Scholarship and Politics in Dependency Studies*. Cambridge, MA: Harvard University Press.

- Papadakis, Elim. 2002. "Global Environmental Diplomacy: Australia's Stances on Global Warming." *Australian Journal of International Affairs* 56, no. 2: 265-277.
- Parmesan, Camille, and Gary Yohe. 2003. "A Globally Coherent Fingerprint of Climate Change Impacts Across Natural Systems." *Nature* 421, no. 6918: 37-42.
- Passé-Smith, John T. 1998. "The Persistence of the Gap Between Rich and Poor Countries: Taking Stock of World Economic Growth, 1990-1993." In *Development and Under-Development: The Political Economy of Global Inequality*. 2d ed. London: Lynne Rienner.
- Paterson, Matthew. 2001. "Risky Business: Insurance Companies in Global Warming Politics." *Global Environmental Politics* 1, no. 4, (November): 18-39.
- Paterson, Matthew, and Michael Grubb. 1992. "The International Politics of Climate Change." *International Affairs (Royal Institute of International Affairs 1944-)* 68, no. 2, (April): 293-310.
- Pearson, Holly L. 2002. "Climate Change and Agriculture: Mitigation Options and Potential." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Pease, Kelly-Kate S. 2000. *International Organizations: Perspectives on Governance in The Twenty-First Century*. New Jersey: Prentice Hall.
- Pellow, David H., Allan Schnaiberg, and Adam S. Weinberg. 2000. *Environmental Politics* 9, no. 1 (spring): 109-137.
- Pepper, David. 1984. *The Roots of Modern Environmentalism*. London: Croom Helm.
- _____. 1985. "Determinism, Idealism, and the Politics of Environmentalism—A Viewpoint." *International Journal of Environmental Studies* 26, no. 1-2 (October): 11-19.
- Pershing, Jonathan, and Fernando Tudela. 2003. "A long-Term Target: Framing the Climate Effort." In *Beyond Kyoto: Advancing the International Effort Against Climate Change*. December. Arlington VA: Pew Center on Global Climate Change.
- Perry, Martin, and Sanjeev Singh. 2001. "Corporate Greening of Foreign Transnationals in Singapore." *Journal of Tropical Geography* 22, no. 1: 52-73.
- Petsonk, Annie, Daniel J. Dudek, and Joseph Goffman. 1998. *Market Mechanisms and Global Climate Change: An Analysis of Policy Instruments*. Environmental Defense Fund in cooperation with the Pew Center on Global Climate Change. Arlington, VA.: Pew Center on Global Climate Change.

- Pigou, A. C. 1920. *The Economics of Welfare*. London: Macmillan.
- Pirages, Dennis. 1997. "Demographic Change and Ecological Security." *Environmental Change and Security Project Report*. Issue 3. Washington D.C.: Woodrow Wilson Center: 37-46.
- Pirages, Dennis C., and Theresa Manley DeGeest. 2004. *Ecological Security: An Evolutionary Perspective on Globalization*. New York: Rowman and Littlefield.
- Pizer, William A. 2001. "Choosing Price or Quantity Control for Greenhouse Gases." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- Poff, N. Leroy, Mark M. Brinson, and John W. Day, Jr. 2002. *Aquatic Ecosystems and Global Climate Change: Potential Impacts on Inland Freshwater and Coastal Wetland Ecosystems in the United States*. January. Arlington, VA: Pew Center on Global Climate Change.
- Powell, Robert. 1991. "Absolute and Relative Gains in International Relations Theory." *American Political Science Review* 85, no. 4, (December): 1303-1320.
- _____. 1994. "Anarchy in International Relations Theory: The Neorealist-Neoliberal Debate." *International Organization* 48, no. 2, (spring): 313-344.
- Pugh, John C. 2003. "New Climate-Change Data Place Policymakers in the Hot Seat" *BioScience* 53, no. 6, (June): 542-543.
- Radner, Roy. 1965. "Competitive Equilibrium Under Uncertainty." *Econometrica* 36, no. 1, (January): 31-58.
- Raustiala, Kal. 2001. "Nonstate Actors in the Global Climate Regime." In *International Relations and Global Climate Change*. Edited by Urs Luterbacher and Detlef F. Sprinz. Cambridge, MA.: MIT Press.
- Rawls, John. 1973. *A Theory of Justice*. Oxford: Oxford University Press.
- Reilly, John M., Henry D. Jacoby, and Ronald G. Prinn. 2003. *Multi-gas Contributors to Global Climate Change: Climate Impacts and Mitigation Costs of Non-CO₂ Gases*. December. Arlington, VA.: Pew Center on Global Climate Change
- Ricardo, David. 1911. *The Principles of Political Economy and Taxation*. London: G. Bell.

- Ringius, Lasse. 1999. *The European Community and Climate Protection*. Report 8. Oslo: Center for International Climate and Environmental Research.
- Roberts, J. Timmons. 2001. "Global Inequality and Climate Change." *Society and Natural Resources* 14: 501-509.
- Roberts, Peter, and Adrian Colwell. 2001. "Moving the Environment to Centre Stage: A New Approach to Planning and Development at European and Regional Levels." *Local Environment* 6, no. 4: 421-437.
- Romer, Paul M. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98, no. 5, pt 2: S71-S102.
- Rondinelli, Dennis A., and Michael A. Berry. 2000. "Corporate Environmental Management and Public Policy." *American Behavioral Scientist* 44, no. 2 (October): 168-188.
- Root, Terry L., and Stephen H. Schneider. 2002. "Climate Change: Overview and Implications for Wildlife." In *Wildlife Responses to Climate Change: North American Case Studies*. Edited by S.H. Schneider and T. L. Root. National Wildlife Federation, Washington D.C.: Island Press.
- Root, Terry L., Jeff T. Price, Kimberly R. Hall, Stephen H. Schneider, Cynthia Rosenzweig, and J. Alan Pounds. 2003. "Fingerprints of Global Warming on Wild Animals and Plants." *Nature* 421, no. 6918: 57-60.
- Rosenbaum, Walter A. 2002. *Environmental Politics and Policy*. 5th ed. Washington D.C.: CQ Press.
- Rosencranz, Armin. 2002. "U.S. Climate Change Policy." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Rosenzweig, C., M.L. Parry, and G. Fischer. 1995. "World Food Supply." In *As Climate Changes: International Impacts and Implications*. Edited by K.M. Strzepek and J.B. Smith. New York: Cambridge University Press: 27-56.
- Rousseau, Jean-Jacques. 1968. *Rousseau: The Social Contract*. Translated and introduced by Maurice Cranston. Baltimore, MD.: Penguin Books.
- Rowlands, Ian H. 2001. "Classical Theories of International Relations." In *International Relations and Global Climate Change*. Edited by Urs Luterbacher and Detlef F. Sprinz. Cambridge, MA.: MIT Press.

- Russett, Bruce M., John R. Oneal, and David R. Davis. 1998. "The Third Leg of the Kantian Tripod for Peace: International Organizations and Militarized Disputes, 1950-1980." *International Organization* 52: 441-467.
- Russett, Bruce M., and John R. Oneal. 2001. *Triangulating Peace: Democracy, Interdependence, and International Organizations*. New York: W.W. Norton & Company.
- Sanstad, Alan H. 1999. "Endogenous Technological Change and the Crowding Out Problem in Climate Policy." Paper presented at the Conference on Economics and Integrated Assessment, Pew Center on Global Climate Change, Washington, D.C., July 21-22.
- _____. 2000. "Endogenous Technological Change and Climate Policy Modeling." In *New Directions in the Economics and Integrated Assessment of Global Climate Change*. Edited by Stephen J. DeCanio, Richard B. Howarth, Alan H. Sanstad, Stephen H. Schneider, and Starley L. Thompson. October. Arlington, VA.: Pew Center on Global Climate Change.
- Sapru, R. K. 1998. "Environmental Policy and Politics in India." In *Ecological Policy and Politics in Developing Countries: Economic Growth, Democracy, and Environment*. Edited by U. Desai. Albany N.Y.: State University Of New York Press.
- Schelling, Thomas C. 1997. "The Cost of Combating Global Warming: Facing the Tradeoffs." *Foreign Affairs* 76, no. 6, (November/December): 8-14.
- _____. 2002. "What Makes Greenhouse Sense? Time to Rethink the Kyoto Protocol." *Foreign Affairs* 82, no. 3, (May/June): 2-9.
- Schlamadinger, Bernard, and Gregg Marland. 2000. *Land Use and Global Climate Change: Forest, Land Management, and the Kyoto Protocol*. June. Arlington, VA.: Pew Center on Global Climate Change
- Schnaiberg, Allan, and Kenneth A. Gould. 1994. *Environment and Society: The Enduring Conflict*. New York, N.Y.: St Martin's Press.
- Schneider, Stephen H. 1997. *Laboratory Earth: The Planetary Gamble We Can't Afford to Lose*. New York: Basic Books.
- _____. 2002. "Earth Systems: Engineering and Management." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.

- Schneider, Stephen H., and Kristin Kuntz-Duriseti. 2002. "Uncertainty and Climate Change Policy." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Schneider, Stephen H., and Starley L. Thompson. 2000. "A Simple Climate Model Used in Economic Studies of Global Change." In *New Directions in the Economics and Integrated Assessment of Global Climate Change*. Edited by Stephen J. DeCanio, Richard B. Howarth, Alan H. Sanstad, Stephen H. Schneider, and Starley L. Thompson. October. Arlington, VA.: Pew Center on Global Climate Change.
- Schneider, Stephen H., Armin Rosencranz, and John O. Niles, eds. 2002. *Climate Change Policy: A Survey*. Washington D.C.: Island Press.
- Schreurs, Miranda. 2003. "Divergent Paths: Environmental Policy in Germany, the United States, and Japan." *Environment* 45, no. 8 (October): 9-17.
- Schroeder, Paul W. 1994. "Historical Reality vs. Neo-realism." *International Security* 19, (summer): 108-148.
- _____. 1994a. *The Transformation of European Politics, 1763-1848*. Oxford: Clarendon Press.
- Schwartz, Peter, and Doug Randall. 2003. "An Abrupt Climate Change Scenario and Its Implications for United States National Security." Emeryville, CA: Global Business Network. On-line. Internet, February. Available from <http://www.gbn.com/ArticleDisplayServlet.srv?aid=26231>.
- Seligson, Mitchell A., and John T. Passé-Smith, eds. 1998. *Development and Under-Development: The Political Economy of Global Inequality*. 2d ed. London: Lynne Rienner.
- Shogren, Jason F., and Michael A. Toman. 2001. "How Much Climate Change is Too Much? An Economics Perspective." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- Shue, Henry. 1999. "Global Environmental and International Inequality." *International Affairs* 75, no. 3: 531-546.
- Simon, Julian. 1996. *The Ultimate Resource 2*. Princeton MA.: Princeton University Press.
- Skolnikoff, Eugene B. 1999. "The Role of Science in Policy: The Climate Change Debate in the United States" *Environment* 41, no. 5, (June): 16-45.

- Smith, Adam. [1776] 1937. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Edited by Edward Canaan. New York: Modern Library.
- Smith, Douglas W., Robert R. Nordhaus, Thomas C. Roberts, Van Ness Feldman, and Marc Chupka. 2002. *Designing a Climate-Friendly Energy Policy: Option for the Near Term*. July. Washington D.C.: Pew Center on Global Climate Change.
- Smith, J. B., S. Huq, S. Lenhart, L. J. Mata, I. Nemesova, and S. Toure, eds. 1996. *Vulnerability and Adaptation to Climate Change: A Synthesis of Results from the U.S. Country Studies Program*. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Snidal, Duncan. 1991. "Relative Gains and the Pattern of International Cooperation." *American Political Science Review* 85: 701-727.
- Snow, Donald M. 2000. *When America Fights: The Uses of U.S. Military Force*. Washington D.C.: Congressional Quarterly Press.
- _____. 2003. *Cases in International Relations: Portraits of the Future*. New York NY: Longman Press.
- Soderbaum, Peter. 2000. *Ecological Economics: A Political Economics Approach to Environment and Development*. London: Earthscan Publications.
- Solingen, Etel. 1996. "Democracy, Economic Reform and Regional Cooperation." *Journal of Theoretical Politics* 8, no. 1: 79-114.
- Sonnenfeld, David A., and Arthur P. J. Mol. 2002. "Globalization and the Transformation of Environmental Governance." *American Behavioral Scientist* 45, no. 9, (May): 1318-1339.
- Soroos, Marvin S. 2001. "Global Climate Change and the Futility of the Kyoto Process." *Global Environmental Politics* 1, no. 2 (May): 1-9.
- Spaargaren, Gert, Arthur P. J. Mol, and Frederick H. Buttel, eds. 2000. *Environment and Global Modernity*. London: Sage.
- Spence, Martin. 2000. "Capital Against Nature: James O'Connor's Theory of the Second Contradiction of Capitalism." *Capital & Class* 72: 81-109.
- Sprinz, Detlef F., and Martin Weiss. 2001. "Domestic Politics and Global Climate Policy." In *International Relations and Global Climate Change*. Edited by Urs Luterbacher and Detlef F. Sprinz. Cambridge, MA.: MIT Press.
- Steans, Jill, and Lloyd Pettiford. 2001. *International Relations: Perspectives and Themes*. London: Longman Press.

- Steel, Brent S., Richard L. Clinton, and Nicholas P. Lovrich, Jr. 2003. *Environmental Politics and Policy: A Comparative Approach*. Boston MA: McGraw-Hill.
- Stein, Arthur. 1982. "Coordination and Collaboration: Regimes in an Anarchic World." *International Organization* 36 (spring): 294-324.
- Stern, David I. 1998. "Progress on the Environmental Kuznets Curve?" *Environment and Development Economics* 3: 173-196.
- Stern, David K. 1999. "The Case for Comprehensive Security." In *Contested Grounds: Security and Conflict in the New Environmental Politics*. Edited by D.H. Deudney and R.A. Matthew. Albany, N.Y.: SUNY Press.
- Stone, Richard. 1995. "If the Mercury Soars, So May Health Hazards." *Science* 267, no. 5200, (17 February): 957-958.
- Thomas, Chris D., Allison Cameron, Rhys E. Green, Michael Bakkenes, Linda J. Beaumont, Yvonne C. Collingham, Barend F.N. Erasmus, Marinez Ferreira de Siqueira, Alan Grainger, Lee Hannah, Lesley Hughes, Brian Huntley, Albert S. van Jaarsveld, Guy F. Midgley, Lera Miles, Miguel A. Ortega-Huerta, A. Townsend Peterson, Oliver L. Phillips, and Stephen E. Williams. 2004. "Extinction Risk from Climate Change." *Nature* 427, (8 January): 145-148.
- Thucydides. 1954. *The History of the Peloponnesian War*. New York: Penguin Books.
- Toke, Dave. 2001. "Ecological Modernisation: A Reformist Review." *New Political Economy* 6, no. 2: 279-291.
- Toke, Dave. 2002. "Ecological Modernisation and GM Food." *Environmental Politics* 11, no. 3, (autumn): 145-163.
- Toman, Michael A., ed. 2001. *Climate Change Economics and Policy: An RFF Anthology*. Washington D.C.: Resources for the Future.
- Toman, Michael A. 2001a. "Moving Ahead with Climate Policy." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- _____. 2001b. "Climate Change Economics and Policies" In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- Tuchman-Mathews, Jessica. 1989. "Redefining Security." *Foreign Affairs* 68, no. 2 (spring): 162-177.

- Turman, Eleanor G. 2001. "Regional Impact Assessments: A Case Study of California." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Tynan, C. T., and D. P. DeMaster. 1997. "Observations and Prediction of Arctic Climate Change: Potential Effects on Marine Mammals." *Arctic* 4: 308-322.
- U.S. Department of Energy, Carbon Dioxide Information Analysis Center (CDIAC). 2003. "On-line Trends: A Compendium of Data on Global Change." On-line. Internet, June. Available from http://cdiac.esd.ornl.gov/trends/emis/em_cont.htm.
- U.S. Environmental Protection Agency (USEPA). 2001. *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-1999*. On-line. Internet, 17 April. Available from http://www.epa.gov/global_warming/publications/emissions/US2001/index.html.
- United Nations Framework Convention on Climate Change (UNFCCC). 1992. *United Nations Framework Convention on Climate Change*. Bonn, Germany: UNFCCC. On-line. Internet, 20 June. Available from <http://unfccc.int/resource/docs/convkp/conveng.pdf>.
- United Nations Framework Convention on Climate Change (UNFCCC, Kyoto Protocol). 1997. *Kyoto Protocol to the United Nations Framework Convention on Climate Change*. Kyoto, Japan: UNFCCC. On-line. Internet, 17 December. Available from <http://unfccc.int/resource/docs/convkp/kpeng.pdf>.
- Valenzuela, J. Samuel, and Arturo Valenzuela. 1978. "Modernization and Dependency: Alternative Perspectives in the Study of Latin American Underdevelopment." *Comparative Politics* 10, no. 4, (July): 535-537.
- Vasquez, John A. 1983. *The Power of Power Politics: A Critique*. New Brunswick, N.J.: Rutgers University Press.
- _____. 1993. *The War Puzzle*. Cambridge: Cambridge University Press.
- _____. 1997. "The Realist Paradigm and Degenerative versus Progressive Research Programs: An Appraisal of Neotraditional Research on Waltz's Balancing Proposition." *The American Political Science Review* 91, no. 4 (December): 899-912.
- Viotti, Paul R., and Mark V. Kauppi. 1999. *International Relations Theory: Realism, Pluralism, Globalism, and Beyond*. 3d ed. Boston: Longman Publishers.
- Vitousek, Peter M., and Harold A. Mooney. 1997. "Human Domination of Earth's Ecosystems." *Science* 277, no. 5325: 494-499.

- Wallerstein, Immanuel. 1974. *The Modern World-System I: Capitalist Agriculture and the Origins of the European World Economy in the Sixteenth Century*. New York: Academic Press.
- Walt, Stephen M. 1998. "International Relations: One World, Many Theories." *International Relations*, (Spring): 30.
- Waltz, Kenneth N. 1959. *Man, the State, and War: A Theoretical Analysis*. New York: Columbia University Press.
- _____. 1979. *Theory of International Politics*. Reading MA.: Addison-Wesley Press.
- Wendt, Alexander. 1994. "Collective Identity Formation and the International State." *American Political Science Review* 88, no. 2, (June): 384-396.
- Wettestad, Jorgen. 1991. "Verification of Greenhouse Agreements: A Mismatch Between Technical and Political Feasibility." *International Challenges* 11, no. 1: 41-47.
- Weyant, John P. 2000. "An Introduction to the Economics of Climate Change Policy." Arlington, VA.: Pew Center on Global Climate Change.
- Wiegandt, Ellen. 2001. "Climate Change, Equity, and International Negotiations." In *International Relations and Global Climate Change*. Edited by Urs Luterbacher and Detlef F. Sprinz. Cambridge, MA.: MIT Press.
- Wiener, Jonathan B. 2001. "Policy Design for International Greenhouse Gas Control." In *Climate Change Economics and Policy: An RFF Anthology*. Edited by Michael A. Toman. Washington D.C.: Resources for the Future.
- _____. 2002. "Designing Global Climate Regulation." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Wigley, Thomas M. L., Richard Richels, and James A. Edmonds. 1996. "Economic and Environmental Choices in the Stabilization of Atmospheric CO₂ Concentrations." *Nature* 379, no. 6562: 240-243.
- Wilbanks, Thomas J., et al. 2003. "Possible Responses to Global Climate Change: Integrating Mitigation and Adaptation." *Environment* 45, no. 5, (June): 28038.
- Willis, Henry. 2002. *Earth's Future Climate*. Coral Springs, FL.: Llumina Press.

- Wilson, Edward O. 1992. *The Diversity of Life*. Cambridge MA: Harvard University Press.
- Wikipedia. 2004. *The Free Encyclopedia*. On-Line. Internet, 3 March. Available from http://en.wikipedia.org/wiki/Neoclassical_economics.
- Wirth, Timothy E., C. Boyden Gray, and John D. Podesta. 2003. "The Future Energy Policy." *Foreign Affairs* 82, no. 4, (July/August): 132-155.
- Wolf, Martin. 2001. "Will the Nation-State Survive Globalization." *Foreign Affairs* 80, no. 1, (January/February): 178-190.
- Wolfson, Richard, and Stephen H. Schneider. 2002. "Understanding Climate Science." In *Climate Change Policy: A Survey*. Edited by Stephen H. Schneider, Armin Rosencranz, and John O. Niles. Washington D.C.: Island Press.
- Woodward, R. T., and R. C. Bishop. 1997. "How to Decide When Experts Disagree: Uncertainty-Based Rules in Environmental Policy." *Land Economics* 73: 492-507.
- World Climate Program. 1985. *Report of the International Conference on the Assessment of the Role of Carbon Dioxide and the Other Greenhouse Gases in Climate Variations*. Geneva, Switzerland: World Meteorological Association.
- World Resources Institute (WRI). 1998. *World Resources*. New York and Oxford: Oxford University Press and World Resources Institute.
- Young, Oren R. 1989. *International Cooperation: Building Regimes for Natural Resources and the Environment*. Ithaca, N.Y.: Cornell University Press.
- Zacher, Mark W., and Richard A. Matthew. 1995. "Liberal International Theory: Common Threads, Divergent Strands." In *Controversies in International Relations Theory: Realism and the Neoliberal Challenge*. Edited by Charles W. Kegley Jr. New York: St. Martin's Press.